VOL. 5 NO. 11
June 15, 1980

Energy Research Abstracts

ABSTRACTS 17311-18298

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UNITED STATES DEPARTMENT OF ENERGY

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Vol. 5, No. 11
ISSN: 0160-3604
CODEN: ERABDZ
June 15, 1980

ENERGY RESEARCH ABSTRACTS

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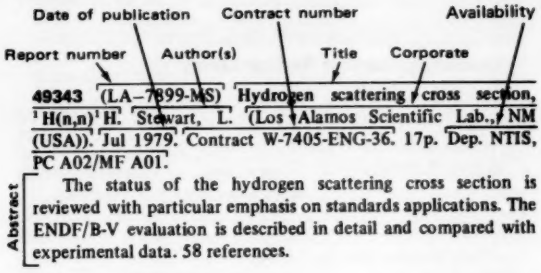
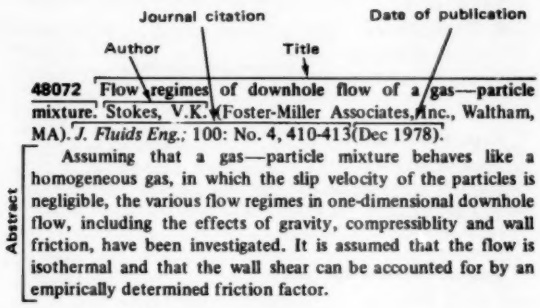

Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
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Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

17311 (FE—3119-8) **Assessment of research projects and expenditures by the coal industry. 8th progress report, July-September 1979.** (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Sep 1979. Contract ET-78-C-01-3119. 24p. Dep. NTIS, PC A02/MF A01.

The objective of this program is to obtain information on the research and development expenditures of the coal mining industry. A large portion of the research undertaken by the coal mining industry is informal and, as such, is not well documented; and expenditures are not generally available. It is the aim of this program to determine the extent and areas of research funded by the coal industry. Companies to be contacted include coal producers, equipment manufacturers, and coal resource developers. The program is planned to encompass all phases of mining research, including health and safety, environment, production, and coal preparation. Results to-date are summarized: Deep mines spent more per ton than surface mines; coal companies reported expenditures in every category, while equipment manufacturers were more limited and the categories were directly related to their line of business; and equipment manufacturers reported 77 percent of expenditures for basic and development research, while coal producers reported 89 percent of expenditures for demonstration and application engineering research. However, some unexpected results included: R and D expenditures appeared to be related to geographical regions; as the coal reserves of a company increased, the R and D expenditures per ton decreased; and 41 percent of research expenditures by coal producers were reported in the mine systems design and human resources categories.

17312 (ORNL/TM—7210) **Fossil energy program progress report for December 1979.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 93p. Dep. NTIS, PC A05/MF A01.

This report - the sixty-fifth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, materials engineering, a coal equipment test program, an atmospheric fluid-bed combustor for cogeneration, engineering studies and technical support, process and program analysis, environmental assessment studies, magnetic beneficiation of dry pulverized coal, technical support to the TVA fluid-bed combustion program, coal cogeneration/district heating plant assessment, chemical research and development, and technical support to major liquefaction projects.

PROCESSING

REFER ALSO TO CITATION(S) 17325, 17327, 17328, 17376, 17836

17313 **Coal conversion and aquatic environments: overview of impacts and strategies for monitoring.** Roop, R.D.; Sanders, F.S.; Barnthouse, L.W. (Oak Ridge National Lab., TN). pp 118-123 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Impact assessment and environmental monitoring are difficult but crucial steps needed to ensure the environmentally safe development of coal conversion technologies. This paper summarizes strategies for impact assessment and monitoring developed at Oak Ridge National Laboratory for DOE's program to build demonstration facilities. Impacts on aquatic environments depend heavily on the abiotic and biotic characteristics of the site and details of facility design. Key issues include availability of water, use of zero-discharge designs, and methods of handling solid wastes. In monitoring programs emphasis is placed on (1) thorough use of existing data, (2) use of a synoptic reconnaissance survey, (3) criteria for choosing parameters to be measured, and (4) the search for ecologically meaningful, cost-effective methods.

17314 **Systematic approach to characterizing energy-environment tradeoffs for coal utilization technologies.** Rubin, E.S. (Carnegie-Mellon Univ., Pittsburgh, PA). pp 124-131 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The types and rates of pollutant emissions from coal utilization systems depend on process design, coal characteristics, and environmental control technology. The latter is determined by environmental regulatory policy which has historically focused on pollutant emissions to a single environmental medium (air, land, or water) without rigorous analysis of the energy and secondary environmental impacts that follow. The present paper describes models developed at Carnegie-Mellon University to systematically address tradeoffs between energy and environmental impacts in the context of conventional and advanced technologies producing electricity from coal.

17315 **Evaluating market prospects for clean coal processes.** Ayers, R.F. (Battelle Columbus Labs., OH). pp 285-290 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The supply/demand balances discussed in this paper present an uncertain picture for the coal process developer. Important points that must be kept in mind are that coal market sectors are expected to continue to grow at different rates, and that uncertainties and policies have additional market and regional impacts. The process developer must understand the ramifications of attempting to enter each market sector. Thus it becomes of great importance to the process developer to know his process and its limitations. If these factors are carefully considered, a business strategy can be formulated based on the strength of the process rather than the peculiarities of the particular marketplace.

CARBONIZATION

REFER ALSO TO CITATION(S) 17357

17316 **Method for operating coke oven chambers in connection with a predrying plant for the coal.** Knappstein, J. (to Firma Carl Still). US Patent 4,176,011. 27 Nov 1979. Priority date 19 Oct 1976, German, Federal Republic of (F.R. Germany), 8p.

Method of operating a coke oven battery arranged in a battery in connection with a predrying or preheating plant for the coal to be coked comprises predrying and preheating coke oven charge moist coal by bringing it into contact with a circulated current of hot inert gas to remove water from the charge with the inert gas comprising a gas containing only a small amount of oxygen

and a remainder comprising nitrogen, carbon dioxide, and steam, charging the preheated and predried coal into a coke oven, directing the coke oven gases generated in the oven out through an offtake, and adding an amount of steam corresponding approximately to the amount of water removed from the charge coal during the predrying and preheating to the coke oven gases in the gas offtake. The apparatus includes a closed circuit in which steam is added to a line and then superheated by a heater and is directed into a secondary flash heater. Fine coal is delivered in a moist condition to a primary flash dryer through which the steam is directed after passing through the preliminary flash dryer and coal treated in the primary flash dryer is directed through a separator and then to the secondary flash heater and out of the flash heater to a conduit for charging it into the coke oven chamber. The steam is contained in a closed cycle and after passing through the preliminary flash heater and the primary flash dryer it is circulated arter separation back to the heater. Any excess steam is removed and passed through a precipitator.

17317 Method for reforming low grade coals. Mori, K.; Taniuchi, M.; Yaguchi, S. (to Kobe Steel, Ltd.). US Patent 4,176,041. 27 Nov 1979. Priority date 24 Feb 1977, Japan, 8p.

In a method for reforming low grade coal to a carbonaceous material suitable for the production of metallurgical coke, steam coal (noncoking coal), such as subbituminous coal, brown coal, etc., is mixed with a catalyst, a co-catalyst (sulfur) and a hydrocarbonaceous heavy oil, and the mixture is thermally reformed in a reducing gaseous atmosphere at elevated pressure and temperature (400° to 450°C) and the resultant reaction mixture is distilled at a reduced pressure of 40 to 150 mm Hg and at a temperature of 280° to 350°C. An iron type catalyst is used in proportions up to 3 wt.% based on the coal (on an ash-free, dry basis). The sulfur and heavy oil are recycled.

17318 Coke oven door seal assembly. Garthus, D.R.; Robinson, L.T. (to Interlake, Inc.). US Patent 4,176,013. 27 Nov 1979. Filed date 23 Jan 1978. 6p.

Assembly for providing a seal between sealing surfaces on a coke oven door and the associated door jamb includes a high temperature-resistant and resilient seal body extending around the entire periphery of the door and secured between retaining members. A steel bearing strip is disposed beneath the seal body between the retaining members and is engaged at spaced-apart points therealong by a plurality of setscrews threadedly engaged through complementary openings in the door for pushing the bearing strip against the seal body and varying the pressure with which it engages the sealing surface on the door jamb.

17319 Inhibiting spontaneous combustion of coal char. Smith, R.H. (to Atlantic Richfield Co.). US Patent 4,170,456. 9 Oct 1979. Filed date 22 Nov 1978. 2p.

A method of inhibiting the spontaneous combustion of coal char which comprises treating coal char with air following by carbon dioxide to deactivate the surface of the coal char to oxygen.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 17341, 17359

17320 (FE—2709-T2) Investigation of high velocity wedge separator for particle removal in coal gasification plants. Quarterly report, October 31, 1979. Linhardt, H.D. (Linhardt and Associates, Inc., Newport Beach, CA (USA)). 31 Oct 1979. Contract EF-77-C-01-2709. 37p. Dep. NTIS, PC A03/MF A01.

Phase IA and II are proceeding concurrently and are leading to meaningful results meeting the basic contract objectives. Significant progress has been made during the reporting period. The parameters governing the collection efficiency have been well identified by theory and experiment. For optimized HTPS geometries, it has been found the Mach-number is of secondary consideration. The velocity ratio of purge flow to main flow at the collection port area should approach unity and the purge to main flow area ratio needs to be optimized for the desired particle range to be separated. In addition, geometries need to be adjusted to accommodate larger particles, which otherwise might bounce and eventually miss the collection slot. Experimental work has demonstrated 99% collection efficiency at design temperature. Additional testing is required in order to provide a complete and consistent data base which will be applied toward the detailed conceptual design of the commercial scale unit.

17321 (IS—4730) Fossil energy quarterly report, October 9, 1979-December 31, 1979. (Ames Lab., IA (USA)). Feb 1980. Contract W-7405-ENG-82. 100p. Dep. NTIS, PC A05/MF A01.

Conditions for the chemical desulfurization of fine-size coals by leaching with hot alkaline solutions containing dissolved oxygen under pressure were investigated further. It was confirmed through experiments conducted with a 1-liter autoclave that about 46% of the organic sulfur can be removed from Illinois No. 6 coal by a single alkaline leaching step. Benefits of acidic and alkaline leaching conditions were compared. At higher oxygen partial pressures (e.g., 200 psia) the removal of pyritic sulfur from Illinois No. 6 coal seems to be favored by oxydesulfurization in an acidic solution while the removal of organic sulfur is favored by oxydesulfurization in an alkaline solution. Treatment of coal with methyl iodide followed by extensive washing with a solvent to remove the reaction products was used to remove approximately one-half of the organic sulfur content in an Iowa high volatile bituminous coal. The pyritic and sulfatic sulfur content was not affected by the methyl iodide treatment. Washing the coal with solvent only did not produce any effect either. On the basis of chemical reactions reported in the literature, it is assumed that the reactive sulfur groups that were removed by this treatment may be organic sulfides or mercaptans. Subsequent leachings of the methyl iodide-treated coal under various conditions of oxydesulfurization did not reduce further the organic sulfur content. The inorganic sulfur content, however, was reduced by the oxydesulfurization steps. It can be assumed that all the reactive and accessible organic sulfur was removed by the methyl iodide treatment, and further chemical desulfurization was directed only against the inorganic sulfur. A laboratory study of various conditions for the froth flotation method of cleaning a high volatile bituminous coal from the Dahm mine in Marion County, Iowa, produced some unusual results.

17322 Coal desulfurization. Anthony, D.B.; Marse, A.V. (to The Standard Oil Company (Ohio)). US Patent 4,168,148. 18 Sep 1979. Filed date 31 Mar 1978. 6p.

The sulfur content of coal can be significantly reduced by leaching the coal with an aqueous solution of sodium sulfite.

17323 Separating liquid and solid products of liquefaction of coal or like carbonaceous materials. Malek, J.M. US Patent 4,159,240. 26 Jun 1979. Filed date 29 Mar 1978. 4p.

Slurryform products of coal liquefaction are treated with caustic soda in presence of H_2O in an inline static mixer, and then the treated product is separated into a solids fraction and liquid fractions, including liquid hydrocarbons, by gravity settling preferably effected in a multiplate settling separator with a plurality of settling spacings.

17324 Cross-flow electrofilter and method. Gidaspow, D.; Lee, C.H.; Wasan, D.T. (to Dept. of Energy). US Patent Application 956,709. 1 Nov 1978. 15p.

The present invention relates to filtering devices that can be employed in clarifying nonaqueous carbonaceous liquids containing fine particles within slurries. It is particularly well adapted for use in clarifying carbonaceous liquid fuels such as those produced in the liquefaction of coal and other solid carbonaceous material. It is an object to provide a filter to remove solid particles suspended within the product of coal liquefaction processes with minimal plugging of the filter openings. It is a further object to provide a method of clarifying carbonaceous liquids containing finely dispersed solids through use of both electrophoretic and cross-flow filtration principles. It is a furter object to provide a method of clarifying liquid produced in the liquefaction of coal in which the electrophoretic mobility of particles and the relative permittivity of the liquid are controlled. In accordance with the present invention, an electrofilter apparatus is provided having an elongated housing with two passageways separated by a lengthwise porous filter medium. The first passageway includes an inlet for the flow of carbonaceous liquid containing solid particles and an outlet for a concentrate of the solid particles in a residual portion of the liquid. A second passageway receives and discharges clarified carbonaceous liquid through the porous filter medium. (LTN)

17325 Coal resources: a continuing assessment. Altschuler, Z.S. (Geological Survey, Washington, DC). pp 249-263 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article discusses our recoverable coal resources, prinicples governing the classification and evaluation of our coal resources, and the potential magnitudes of the trace element burdens of coal. Dynamic changes in mining technology and practice impose a need to revise our criteria for classification of coal resources. Such reappraisal may reveal substantial increases in total coal reserves and in reserves of low-sulfur coal in the US.

17326 Technologies for the chemical desulfurization of coal. Meyers, R.A. (TRW, Redondo Beach, CA). pp 273-276 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses technologies for the chemical desulfurization of coal and covers such subjects as inorganic sulfur removal mechanisms, organic sulfur removal mechanisms, potential desulfurization reagents and products, SO/sub x/ control for industrial/ commercial boilers, and SO_2 emission standards.

17327 Coal utilization options. Warnke, W.E. (Dept. of Energy, Washington, DC); Holt, E.C. Jr. pp 291-298 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper addresses and compares the economics of possible compliance options such as (1) transporting western oil; (2) installing flue gas scrubbers; (3) purchasing physically cleaned coal; or (4) using prepared coal in conjunction with flue gas scrubbing. A comparative analysis is presented which enumerates the costs of compliance in selected geographic areas for the various options.

17328 Market-based analysis of sulfur removal strategies for Kentucky coals. Jones, J.E. Jr. (Univ. of Kentucky, Lexington); Nicholson, A.F. pp 299-305 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper examines the Kentucky coal market requirements and some washing-based alternatives which may prove to be more economical and more efficient methods for burning the coal in compliance with emission standards.

17329 Retrofit of FBC to industrial boilers. Weller, A.E. (Battelle Columbus Labs., OH). pp 404-408 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Fluidized-bed combustion (FBC), where the coal is burned in a fluidized bed of limestone, is regarded as a promising alternative to stack scrubbers for SO_2 control. Anticipated costs are lower than for a boiler plus scrubber, and there are fewer problems in disposing of the waste product. Retrofitting would minimize the capital required for conversion to coal and allow a more rapid penetration of the new FBC technology as compared to conversion to completely new equipment.

HYDROGENATION

17330 Catalysis of hydrogen transfer in a tetralin-coal system. Tsai, M.C.; Weller, S.W. (State Univ. of New York, Buffalo). *Fuel Process. Technol.;* **2**: No. 4, 313-316(Oct 1979).

Hydrogen transfer from donor solvents to coal has been studied since the development of the Pott-Broche process. Such hydrogen transfer occurs in the absence of external (added) catalysts. Possible catalysis of the hydrogen transfer by external catalysts has apparently received little attention. This communication is concerned with hydrogen donation from tetralin to coal in the presence of either cobalt-molybdate -alumina ($CoO/MoO/Al_2O_3$) or stannous chloride ($SnCl_2.2H_2O$). The former is known to be outstanding for hydrodesulfurization, the latter for hydroliquefaction of coal. Procedures and calculational methods differed in detail from those described by Neavel, but definitions of hydrogen transfer and coal conversion are the same as his.

GASIFICATION

REFER ALSO TO CITATION(S) 17320, 17348, 17349, 18093

17331 (ANL/CEN/FE—79-4) **Laboratory support for in situ gasification: reaction kinetics. Annual report October 1977-September 1978.** Young, J.E.; Wong, S.H.; Johnson, J.E.; Sikand, N.; Jonke, A.A. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 39p. Dep. NTIS, PC A03/MF A01.

This work is directed toward support studies for the national program for the development and demonstration of in situ coal gasification processes. The objective of this work is to determine the reaction-controlling variables and reaction kinetics for the gasification of chars obtained by pyrolyzing coal in simulated underground gasification conditions. The reactions being studied and to be studied include steam-char, CO_2-char, H_2-char, the water-gas shift reaction, and the methanation reaction. In this report are presented data regarding the kinetics of the reaction of steam with chars prepared from Pittsburgh seam high-volatile bituminous coal. In addition, a reaction model is described correlating the steam-char reaction rates measured earlier for Hanna subbituminous coal with operating conditions including temperature, partial pressures of steam and hydrogen, and extent of carbon gasification. Partial results are presented and discussed for an investigation of structural parameters of Hanna char as a function of pyrolysis conditions and extent of carbon gasified.

17332 (FE—2577-1(Vol.1)) **Demonstration plant process and conceptual mechanical design. Volume I. Synthesis gas demonstration plant program, Phase I.** (Grace (W.R.) and Co., Memphis, TN (USA); Ebasco Services, Inc., New York (USA)). Sep 1979. Contract EF-77-C-01-2577. 299p. Dep. NTIS, PC A13/MF A01.

Some of the requirements of the coal gasification and carbon/ ash separation system are that it shall: be capable of operation at high pressure (1200 psig for the Demonstration Plant); operate with a relatively low reaction temperature (increases refractory life and improves slag properties); produce a synthesis gas free from tars and phenols, which shall be capable of purification by existing conventional means and at reasonable cost; achieve a high carbon conversion factor yielding good thermal efficiency and high content of H_2 and CO in the synthesis gas; produce an environmentally acceptable slag for disposal as landfill; have been demonstrated satisfactorily at least on a pilot plant scale; gasify coal having high sulfur content, low heating value and high swelling index (i.e. coal of relatively low cost and high availability); and be capable of development into large scale single stream units. The Texaco Coal Gasification Process, which includes the removal and subsequent separation and recycle of ash and unconverted carbon char, satisfactorily fulfills the minimum requirements enumerated above and was selected for the demonstration plant. The plant design is described and shown in diagrams. The various plant systems are described and an estimate is made of the technical and economic risks involved.

17333 (FE—2577-1(Vol.2)) **Demonstration plant process and conceptual mechanical design. Volume II. Synthesis gas demonstration plant program, Phase I.** (Grace (W.R.) and Co., Memphis, TN (USA); Ebasco Services, Inc., New York (USA)). Sep 1979. Contract EF-77-C-01-2577. 489p. Dep. NTIS, PC A21/MF A01.

The engineering effort for the Demonstration Plant resulted in the developments of an equipment index, process duty specification sheets, plant arrangement drawings, and a scale model. This section includes these documents as well as the site and plot plans, a description of storage facilities, and a description of the plant communication system.

17334 (FE—2577-1(Vol.3)) **Demonstration plant process and conceptual mechanical design. Volume III. Synthesis gas demonstration plant program, Phase I.** (Grace (W.R.) and Co., Memphis, TN (USA); Ebasco Services, Inc., New York (USA)). Sep 1979. Contract EF-77-C-01-2577. 327p. Dep. NTIS, PC A15/MF A01.

This volume includes the process duty specification sheets prepared for the Demonstration Plant.

17335 (FE—2577-1(Vol.4)) **Demonstration plant process and conceptual mechanical design. Volume IV. Synthesis gas demonstration plant program, Phase I.** (Grace (W.R.) and Co., Memphis, TN (USA); Ebasco Services, Inc., New York (USA)). Sep 1979. Contract EF-77-C-01-2577. 244p. Dep. NTIS, PC A11/MF A01.

As part of the design effort for the Synthesis Gas Demonstration Plant Program, several project documents, standards and specifications were prepared. These items included drawing standards, piping specifications, codes and standards, buildings criteria, a site preparation specification, an underground sewage and drainage specification, scoping piping layouts and flow diagrams. This volume includes the descriptions of these items.

17336 (FE—2577-5) **Demonstration plant process engineering report. Synthesis gas demonstration plant program, Phase I.** (Grace (W.R.) and Co., Memphis, TN (USA); Ebasco Services, Inc., New York (USA)). Sep 1979. Contract EF-77-C-01-2577. 229p. Dep. NTIS, PC A11/MF A01.

Task 1.2 of the Synthesis Gas Demonstration Plant Program represents the design effort for the Demonstration Plant. In accordance with the requirements of this Task, a Process Engineering Report has been prepared. This report serves to record the basis for the process design and includes process descriptions and a discussion of the rationale for process decisions made during the project design.

17337 (FE—2616-T2) **Coal pump development and technical support project. Quarterly technical status report, July 2-September 30, 1979.** Phen, R. (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EF-77-A-01-2616. 31p. Dep. NTIS, PC A03/MF A01.

Work on assessing the full feeding system requirements for new gasification processes is proceeding. Performance testing of experimental feeders is also reported. Experiments on extruding coal at high temperatures and atomizing the extruded coal with warm gaseous nitrogen were demonstrated. (LTN)

17338 Flexible conduit for effecting lateral channelling in coal or oil shale beds. Sabol, K. US Patent 4,168,752. 25 Sep 1979. Priority date 20 Dec 1976, United Kingdom of Great Britain and Northern Ireland (UK), 4p.

There is provided in accordance with the invention apparatus and a method for boring holes through carbonaceous deposits. The method involves the step of introducing combustion-supporting gases such as air under pressure through the apparatus installed in a well hole opposite the area to be bored. The apparatus comprises inner and outer flexible tubes with flexible, jointed armour and a directional nozzle which permits it to be bent and change attitude as necessary. The adjacent carbonaceous interface after being ignited is maintained in this condition by the combustion-supporting gas which is supplied under pressure. As the combustion proceeds, the pressure expels the combustion products and the gas injector is advanced along the channel it has previously formed.

17339 Method of operating a coal gasifier. Blaskowski, H.J. (to Combustion Engineering, Inc.). US Patent 4,168,956. 25 Sep 1979. Filed date 18 Aug 1977. 4p.

A method of operating an entrained flow coal gasifier which comprises the steps of firing coal at two levels in a combustion zone with near stoichiometric air, removing molten ash from the combustion zone, conveying combustion products upwardly from the combustion zone through a reduction zone, injecting additional coal into the combustion products in the reduction zone and gasifying at least a portion of the coal to form low BTU gas, conveying the gas to a point of use, including also reducing gasifier output by modifying the ratio of air to coal supplied to the upper level of the combustion zone so that the ratio becomes increasingly substoichiometric thereby extending the gasification of coal from the reduction zone into the upper level of the combustion zone, and maintaining the lower level of coal in the combustion zone at near stoichiometric conditions so as to provide sufficient heat to maintain effective slagging conditions.

17340 Combination hydroconversion, fluid coking and gasification. Metrailer, W.J.; Bearden, R. Jr.; Aldridge, C.L. (to Exxon Research and Engineering Co.). US Patent 4,169,038. 25 Sep 1979. Filed date 24 Mar 1978. 8p.

A combination slurry hydroconversion, coking and coke gasification process is provided wherein solid fines having an average particle size of less than 10 microns in diameter or the ashes thereof recovered from a gaseous product derived from the coke gasification are used as a catalyst in the hydroconversion stage.

17341 Process for removing arsenic and/or antimony from oil shale distillate or coal oil. Simo, T. (to Metallgesellschaft Aktiengesellschaft). US Patent 4,159,241. 26 Jun 1979. Priority date 4 Oct 1976, German, Federal Republic of (F.R. Germany), 2p.

An improvement in a process of removing arsenic and/or antimony from their chemical compounds in a substantially organic liquid by treating the latter with hydrogen under a superatmospheric pressure and at an elevated temperature is described. The improvement residing in applying this process to the liquid distillate of oil shale or coal or one derived from the gasification of coal. The liquid containing oil shale dust or coal dust whereby elementary arsenic and/or antimony is deposited on the oil shale dust or the coal dust and the oil shale dust or the coal dust containing elementary arsenic and/or antimony is removed therefrom.

17342 Coal treatment apparatus. Cramer, F.B. (to Clean Energy Corp.). US Patent 4,158,697. 19 Jun 1979. Filed date 26 Oct 1976. 16p.

Apparatus for the processing of solid fuel hydrocarbons including a reactor for hydrogenation of the fuel reactant and a combustion reactor for oxidation of the residuum from the first reactor, the solid fuel reactant being dissolved in molten salt throughout its processing; and heat recovery means including a molten metal loop and a steam loop whereby the excess heat from the hydrogenation and oxidation reactors, present in the molten salt reaction matrix, is recovered in molten metal and transferred to the steam loop for energy production while avoiding cross contamination of the steam loop with salt from the reaction loop, and vice-versa.

17343 Apparatus and method for feeding coal into a coal gasifier. Bissett, L.A.; Friggens, G.R.; McGee, J.P. (to Dept. of Energy). US Patent 4,153,427. 8 May 1979. Filed date 23 Feb 1978. 6p.

PAT-APPL-880,820.

This invention is directed to a system for feeding coal into a gasifier operating at high pressures. A coal-water slurry is pumped to the desired pressure and then the coal is dried prior to feeding the coal into the gasifier by contacting the slurry with superheated steam in an entrained bed dryer for vaporizing the water in the slurry.

17344 Solids feeder apparatus. Bell, H.S. Jr. (to Dept. of Energy). US Patent 4,150,759. 24 Apr 1979. Filed date 1 Dec 1977. 6p.

PAT-APPL-856,365.

This invention sets forth a double-acting piston, which carries a floating piston, and which is reciprocated in a housing, for feeding coal to a high pressure gasifier system. The housing has a plurality of solids (for instance: coal) in-feeding ports and a single discharge port, the latter port being in communication with a high pressure gasifier system. The double-acting piston sequentially and individually communicates each of the in-feeding ports with the discharge port. The floating piston both seals off the discharge port while each in-feeding port is receiving coal or the like, to prevent undue escape of gas from the gasifier system, and translates in the housing, following a discharge of coal or the like into the discharge port, to return gas which has been admitted into the housing back into the gasifier system.

17345 Solid feeder and method. Hathaway, T.J. (to Dept. of Energy). US Patent 4,148,405. 10 Apr 1979. Filed date 1 Dec 1977. 10p.

PAT-APPL-856,367.

This invention provides a housing containing a rotatable coal bucket that is sealed at its ends in the housing with a reciprocal plunger that is sealed in the bucket at one end and has an opposite cone-shaped end that wedges up against a closed end of the bucket, and a method for feeding dry, variable size coal from an ambient atmosphere at low pressure into a high temperature, high pressure reactor between the seals for producing fuel gas substantially without losing any high pressure gas from the reactor or excessively wearing the seals. To this end, the piston biases the plunger back and forth for loading and unloading the bucket with coal along an axis that is separated from the seals, the bucket is rotated to unload the coal into the reactor so as to fill the bucket with trapped high pressure gas from the reactor while preventing the gas from escaping therefrom, and then the cone-shaped plunger end is wedged into mating engagement with the closed end of the bucket to displace this high pressure bucket gas by expelling it back into the reactor whereby the bucket can be re-rotated for filling it with coal again substantially without losing any of the high pressure gas or excessively wearing the seals.

17346 Occupational health and safety in coal gasification pilot plants. Evans, J.M. (Enviro Control, Inc., Rockville, MD). pp 507-512 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

There is little doubt that coal conversion processes do indeed have the potential for exposing workers on these processes to hazardous conditions and materials. The questions are: what is the extent of this exposure; what is the effect of this exposure on the worker. We suggest that the program outlined here, which is detailed in the Recommended Health and Safety Guidelines for Coal Gasification Pilot Plants as submitted to NIOSH, will both protect the worker in the pilot plants on a real-time basis and help to answer many questions concerning the commercial plants of the future. With the information in this report plant designers can anticipate health problems and avert them in the initial plant design, which means that the employees of commercial coal gasification plants will be protected from the time of construction and that the cost of such protection to the employer will be significantly lower than that of retrofitting. As for the pilot plant program, the procedures recommended here have been or are being instituted at one or more of the pilot plants that ERDA/DOE currently operates. The difference is in the use to which these procedures will be put, and to the fact that this constitutes a complete integrated program.

17347 Toward building a safe and healthful coal gasification industry. Young, R.J.; Cohen, M.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH). pp 513-518 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Most of the potential occupational safety and health problems associated with coal gasification are analogous to those previously experienced in the chemical, petrochemical, coal, and coal tar processing industries. Hazard control procedures developed in these industries generally are applicable to coal gasification. The complexity of the potential hazards calls for both innovative control strategies and careful forethought in plant design.

LIQUEFACTION

REFER ALSO TO CITATION(S) 17323, 17324, 17340, 17342, 17354

17348 (FE—2307-50) **Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). Project 61001 annual report, April 1, 1978-March 31, 1979.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1979. Contract EX-76-C-01-2307. 128p. Dep. NTIS, PC A07/MF A01.

The effects of operating pressure and heating rate on reactor performance were studied. In addition, several techniques for processing caking coals were explored, and trials of bentonite clay and iron oxide as catalysts were made. In the bench-scale unit program, the main findings can be summarized as follows: At low operating pressure, carbon conversion is low, and increases as operating pressure increases; at high heating rates with negligible residence time at maximum temperature, carbon conversions are reduced, and phenols and cresols form a substantial fraction of the hydrocarbon liquid products; over the range of heating rates studied thus far, liquid yields are better at lower heating rates; in a cocurrent heating mode, the distribution of carbon among products was found to correlate with severity function; unpretreated caking coals can be processed using silica sand or char as inert diluents; caking coal can be pretreated with lime under mild conditions and successfully processed in the bench-scale unit; both bentonite clay and iron oxide have potential catalytic effects, allowing good carbon conversions at low hydrogen to-coal weight ratios. Some support studies were made using the bench-scale unit and other equipment to clarify certain aspects of the PDU in the operation of the preheater and in the operation of the combustor sections. The main findings from these studies are summarized.

17349 (FE—2307-55) **Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (riser cracking of coal). Quarterly report, April 1-June 30, 1979.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Institute of Gas Technology, Chicago, IL (USA)). Nov 1979. Contract EX-76-C-01-2307. 28p. Dep. NTIS, PC A03/MF A01.

Experimental runs using hydrogen preheated to pyrolysis temperatures to process North Dakota lignite in the bench-scale unit were continued, completing the studies of the effect of heating rate on the conversion of feed carbon and the distribution of products among gases, hydrocarbon liquids, and spent char. A comparison was then made of product distributions obtained by hot hydrogen processing and by concurrent heating of the lignite and hydrogen to pyrolysis temperatures. The distributions of feed carbon among carbon oxides, methane, ethane,, and hydrocarbon liquids were similar, and the yield of hydrocarbon liquids was practically identical. Construction of the process development unit has been essentially completed, and shakedown tests are now in progress. Equipment problems encountered thus far have been minor and should be easily corrected. An equipment flow sheet for a process plant has been developed, and the evaluation of various processing options has begun.

17350 (FE—2307-58) **Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels: Riser cracking of coal. Project 61001 quarterly report, July 1-September 30, 1979.** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1979. Contract EX-76-C-01-2307. 23p. Dep. NTIS, PC A02/MF A01.

The main effort was directed toward the shakedown runs in the PDU. A number of equipment problems surfaced which have been, or are being, corrected. The combustion system has been operated successfully, and some short runs have been made in which both liquids and gases have been produced. Longer runs at hydrogen-to-coal ratios of 0.2 to 0.3 will be made during the forthcoming quarter. From work done in the bench-scale unit it has been found that a large fraction of steam in the carrier gas significantly alters the distribution of carbon among products. Carbon oxide yields are increased and hydrocarbon liquid yields are decreased; ethane yields were essentially unchanged, and methane yields were decreased slightly. An equipment flow sheet for a commercial hydropyrolysis plant for producing fuel gases, blending gasoline constituents, and fuel oil from coal has been developed and is being used as a base case for process analysis. A number of processing options have become apparent that will require a further analysis before estimates of total plant investment and selling prices of products can be completed.

17351 (IS—4729) **Alloy evaluation for fossil fuel process plants (liquefaction). Quarterly report, 1 October-31 December 1979.** Woods, C.M.; Scott, T.E. (Ames Lab., IA (USA)). Feb 1980. Contract W-7405-ENG-82. 26p. Dep. NTIS, PC A03/MF A01.

Baseline J/sub IC/ data were determined for A387-74A-Gr.22-Cl.2 steel in 800°F argon gas at ambient pressure. Random samples of the Kentucky bituminous used for coal slurry exposures were analyzed for total sulfur and chlorine content. Phase stability diagrams for Fe, Cr, Mo, and Mn in H_2S/H_2-0, H_2S/H_2-C, and C-0 environments were derived and are presented. An electrically isolated loading cage including specimen grips and universal joint were designed and built for use in crack growth studies with our five inch I.D. autoclave dynamic test facility.

17352 (PETC/TR—80/4) **Past trends in synthetic fuels R and D.** Schlesinger, M.D. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). Mar 1980. 16p. Dep. NTIS, PC A02/MF A01.

The trends in synthetic fuels research programs in the USA are reviewed with some emphasis on work of the US Bureau of Mines, Office of Coal Research, ERDA and DOE. (LTN)

17353 Hydrogenation of coal liquid utilizing a metal carbonyl catalyst. Feder, H.M.; Rathke, J.W. (to Dept. of Energy). US Patent 4,152,248. 1 May 1979. Filed date 2 May 1978. 8p.

PAT-APPL-902,182.

Coal liquid having a dissolved transition metal, catalyst as a carbonyl complex such as $Co_2(CO_8)$ is hydrogenated with hydrogen gas or a hydrogen donor. A dissociating solvent contacts the coal liquid during hydrogenation to form an immiscible liquid mixture at a high carbon monoxide pressure. The dissociating solvent, e.g., ethylene glycol, is of moderate coordinating ability, while sufficiently polar to solvate the transition metal as a complex cation along with a transition metal, carbonyl anion in solution at a decreased carbon monoxide pressure. The carbon monoxide pressure is reduced and the liquids are separated to recover the hydrogenated coal liquid as product. The dissociating solvent with the catalyst in ionized form is recycled to the hydrogenation step at the elevated carbon monoxide pressure for reforming the catalyst complex within fresh coal liquid.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 17325, 17366

PROPERTIES

17354 Influence of hydrogen bonding onthe viscosity of coal liquids. Tewari, K.C.; Hara, T.; Young, L.J.S.; Li, N.C. (Duquesne Univ., Pittsburgh, PA). *Fuel Process. Technol.;* 2: No. 4, 303-311(Oct 1979).

Viscosity, infrared, and proton magnetic resonance studies are reported on the SRC II process solvent (before fractionation), and its acid + neutral fraction, and on the interaction of these coal liquids with quinoline and triethylamine. The results obtained with the coal liquids and with several model compounds suggest that hydrogen bonding involving largely phenolic OH and nitrogen-containing bases, -O-H...N-, gives rise to proton-transfer complexes, $-O^{-}...^{+}H-N-$, which is in part responsible for the viscosity and non-Newtonian flow of the coal liquids. 6 figures, 3 tables.

17355 Coal-sample size for determination of volatile matter and ash content. Gorelov, P.N.; Butina, I.V. *Coke Chem., USSR (Engl. Transl.);* No. 10, 23-27(1977).

Translated from Koks Khim.; No. 10, 17-19(1977).

We became interested in making a metrological evaluation of the extent to which a minimum sample is representative in determination of the ash content and volatile matter of coals (using portion weights of from 0.2 to 1.2 g). Experiments were performed to determine the extent to which the accuracy of the results was affected by such factors as the degree of coal comminution, the heating regime with different sample-layer thicknesses, and sample weight. It was also necessary to modify the analysis conditions, especially those pertaining to sample preparation. The results yielded by determination of volatile-matter content with even minimal weighed portions (0.2 and 0.4 g) fell within the permissible range stipulated by State Standards in 80% of all cases; the other 20% of the results were somewhat high (the discrepancy amounted to as much as 0.6%). This enabled us to recommend that portions weighing from 0.2 to 0.6 g be used for analysis when necessary, observing the analytic rules recommended for small portions, including those pertaining to sample preparation. Weighing must be to within +- 0.0002 g for analysis of small samples. In contrast to the situation for coal-tar-pitch samples, the results of volatile-matter determinations made with portions weighing 0.4 to 1.2 g are independent of the heating rate, sample size, and crucible mass. This is, in all probability, related to the nature of the coal organic matter and the kinetics of pyrolysis, as well as to the fact that the volatile-matter content is lower than that of pitch. The fact that methods have been verified metrologically which permit investigation of small samples, providing data of known accuracy, will expand opportunities for research and reduce research costs. (LTN)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 17689, 17690, 17961, 17962, 17963, 17964, 17965, 17967

17356 (IS—4731) Direct utilization-recovery of minerals from coal fly ash. Fossil Energy Program. Technical progress report, 1 October 1979-31 December 1979. Burnet, G.; Murtha, M.J. (Ames Lab., IA (USA)). Mar 1980. Contract W-7405-ENG-82. 20p. Dep. NTIS, PC A02/MF A01.

Research is focused on the development of methods for recovering minerals from power plant fly ash. Definition and refinement of steps in the high-temperature (HiChlor) gas chlorination process and in the lime-soda sinter process are emphasized. Samples of chlorinated ash residues were analyzed to determine changes in physical structure and to measure compositions of individual particles. The results show that when ash particles are fractured by heat treatment the chlorination of contained alumina and iron is more complete. The use of $SiCl_4$ as a chlorination agent in addition to chlorine was studied as a method to reduce the amount of silica being chlorinated. Optimum conditions for $SiCl_4$ partial pressure and reaction temperature reduced the percentage of silica chlorinated from 20% without $SiCl_4$ to about 5%, with minimal reduction in the percentage of alumina reacted. Evaluation of waste FGD sludges and FBC residues for use as lime resources in the lime-soda sinter process has begun, and further research was conducted on high-pressure desilication of sinter extraction filtrates. At optimum conditions, the concentration of dissolved silica was reduced by 60%, but this is still in excess of the silica specification for alumina used in metal production. Chemical beneficiation of magnetically separated fly ash showed that the contained silica dissolves quickly during a high-pressure alkali extraction, and that most of the contained alumina is dissolved after one-half hour. Development of a two-stage process, first dissolving the silica and then the alumina in even less time, shows promise of further reducing the size and cost of the extraction equipment required.

17357 Process for the separation of foam from effluents of coke oven plants. Husher, L.K.; Weber, H.; Tippmer, K. (to United States Steel Corp.). US Patent 4,176,062. 27 Nov 1979. Filed date 4 Jan 1977. 6p.

Tar and coal fines are separated from ammonia liquor in a coke making operation by a series of settling steps including one in which a foam is physically removed from the surface area of a decanter and placed in a separate decanter.

17358 Process for converting coal ash slag into portland cement. Fondriest, F.F. (to Standard Oil Co. (Indiana)). US Patent 4,174,974. 20 Nov 1979. Filed date 14 Apr 1978. 10p.

Disclosed is a manufacturing process for converting coal ash slag from a slagging coal gasifier into a marketable cement product having the characteristics and qualities of portland cement. This process comprises the steps of transferring molten slag from a slagging coal gasifier to a melt chamber and reacting it with a mineral containing lime, for example: calcium oxide, calcium hydroxide or calcium carbonate, to form a homogeneous cement product. This cement product is then transferred to a quench chamber where it is allowed to cool and solidify in the form of clinkers, which are later reduced to powder form. This process also provides an efficient means to conserve energy when producing a portland cement and provides an effective and economical way to dispose of a waste product while increasing the cost efficiency of a slagging coal gasifier.

17359 Disposal of flue gas cleaning effluents. Hagerty, D.J.; Ullrich, C.R. (Univ. of Louisville, KY). pp 74-78 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Increasing emphasis on the use of coal, the presence of sulfur in most economically minable American coals, and concurrent efforts to improve air quality by reducing sulfur emissions, have led to the development of numerous viable flue gas cleaning methods. Scrubbing with lime or limestone slurries, with land disposal of generated sludges, appears to be the most practicable flue gas cleaning techniques for SO/sub x/ removal at the present time.

17360 Solvent regeneration of activated carbon for water pollution control. Himmelstein, K.J.; Sutikno. (Univ. of Kansas, Lawrence). pp 548-553 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article discusses a beginning effort on the study of solvent regeneration. Solvent regeneration of carbon in contact with realistic wastes streams must be demonstrated. Future work will include extensive testing of the system with realistic industrial, agricultural, and municipal wastes to determine realistic operational capabilities.

17361 Treatment system for the recovery and reuse of electronic/metal finishing waste water. Miller, D.G. (Western Electric Co., Inc., Lees's Summit, MO). pp 554-559 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A 200,000-gallon per day industrial waste water reuse system is in operation at Western Electric Company's Kansas City manufacturing plant. The reuse system includes automated diverter valves which select low acidic waste from electronic/metal finishing processes. This selected waste is transferred to a disc filter and a high rate anthracite coal filter for solids and oil removal. The water is then neutralized by passing through a weak base anion resin exchanger. This treated water is used as feed for a demineralizer system and as makeup for a large cooling tower. The quality of the recovered water is found to be much lower in total dissolved solids than the local city water supply. This quality factor results in a substantial saving in regenerant chemical when the reuse water is used to feed the demineralizer system. Data are developed to determine the savings in water and regenerant chemcials for similar reuse systems up to capacities of over a million gallons per day and for a wide range of waste water quality.

17362 Environmental evaluation of ash disposal at coal-fired power plants. Chu, T.Y.J.; Ruane, R.J.; Milligan, J.D.; Kim, B.R. (Tennessee Valley Authority, Chattanooga). pp 565 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper describes evaluation of ash disposal at coal-fired power plants. The type of coal burned, ash content of the coal, ash fusing temperature of the coal, extent and efficiency of ash removal facilities, and method of firing determine the amounts of ash produced. The main advantages of wet disposal over dry disposal are simplicity of operation, minimization of dust problems, and availability of ash ponds as wastewater treatment systems.

17363 Implications of the air quality standards interpretive ruling: emission offset requirements. Fetter, J.B.; Hollander, H.I. (Gilbert/Commonweatlh Associates, Reading, PA). pp 567 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The paper discusses the emission offset ruling and problems in meeting acceptable standards. Air quality policy decisions must be made to make coal a reasonable power option. If air quality requirements for coal-fired generation become too stringent, this cannot be accomplished.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 17313, 17314, 17357, 17390, 17690, 18001, 18023, 18081

17364 Approximate original contour: the end of creative reclamation and effective land-use planning. Robins, J.D. (Skelly and Loy, Harrisburg, PA). pp 14-17 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article discusses the shortcomings of a tunnel-vision reclamation policy and draws attention to the opportunities for positive impacts to be realized from effective reclamation planning. The author believes the American public should provide stimulus and encouragement to the mining industry.

17365 Ambient air quality assessment of the SYNTHANE coal gasification pilot plant, six month study, August 1976-January 1977. Scott, R.L.; Ladesic, R.P. (Dept. of Energy, Pittsburgh, PA). pp 200-205 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

DOE is supporting the development of the SYNTHANE process for synthetic nautral gas production from coal at the Pitts-

burgh Energy Research Center. The development of this technology is progressing in conjunction with studies of technological environmental implications. This paper briefly describes the second phase results and conclusions relative to the ambient air monitoring program at the SYNTHANE pilot plant. This study was conducted from August 1976 through January 1977. A description is provided regarding the site characteristics and the associated air monitoring system for the SYNTHANE pilot plant - plus the plans for continued ambient air monitoring that will make this continuing effort significant in assessing the air quality impacts of coal gasification.

17366 Coal fired power plant trace element study. Thoem, T.L. (Environmental Protection Agency, Denver, CO). pp 223-229 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Five large coal fired power plants have been investigated within the context of two projects over the past two years to determine the fate and characteristics of trace elements during coal combustion. A material balance approach was used for a quantitative examination of twenty-seven inorganic elements during the initial program at three plants. An additional twenty-six elements were surveyed semi-quantitatively. The selection of plants with different boiler configurations, different particulte control devices and slightly different coal characteristics provided a comparison of trace element emissions as a function of plant design and operating parameters. Results of the initial program showed that the elements could be broadly classified into three general groups: (1) those uniformly distributed in the coal ash, (2) those preferentially emitted with the fly ash, and (3) those emitted as vapors in the flue gas.

17367 Economic and environmental impacts of the Federal Coal Conversion Program. Devitt, T.W.; Ponder, T.C. Jr. (PEDCo Environmental, Inc., Cincinnati, OH). pp 237-242 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses the October 1973 oil embargo that prompted the Energy Supply and Environmental Coordination Act of 1974 (known as ESECA). ESECA provides for the expansion of the usage of the US coal reserves and considers the environmental consequences of such action. The act provides DOE with the authority to demand existing and future electric utility power plants and other major fuel-burning installations to fire coal and decrease the use of petroleum and natural gas.

17368 National coal utilization assessment: some potential impacts in the south. Davis, R.M.; Honea, R.B.; Dobson, J.E.; Berry, L.G. (Oak Ridge National Lab., TN). pp 453-461 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The National Coal Utilization Assessment has uncovered some of the potential social, economic, and environmental effects of energy development and use in the South. The siting requirements, water resource, and socioeconomic effects of coal development and use in the southern region are significant. Regional integrated assessments such as the NCUA should be valuable to federal and regional policy makers in determining the impacts and tradeoffs between alternative fuel cycles as well as alternative energy technologies within fuel cycles.

RESERVES AND EXPLORATION

17369 (DOE/ET/09009—T1) **Evaluation of the coal reserves in the Whitwell Shale in the Southern Cumberland Plateau in Tennessee. Final report.** Wilson, R.L.; Warren, G.F.; Milici, R.C. (Tennessee Univ., Chattanooga (USA). Dept. of Geosciences). May 1979. Contract ET-77-G-01-9009. 82p. Dep. NTIS, PC A05/MF A01.

The Southern Tennessee Coal Field comprises some 14,000 square miles of the Cumberland Plateau Physiographic Province and includes all or parts of 11 counties. The coal measures belong to the Lower Pennsylvanian System. The largest coal potential lies with the Richland and Sewanee seams, which are contained in the Whitwell Shale. The methods of obtaining coal reserve data in this report are adaptations of those used by the Tennessee Division of Geology, US Bureau of Mines, and US Geological Survey. This study differs from previous coal reserve estimates in that emphasis is placed on recoverable underground reserves as well as strippable reserves. Conservative premises were used throughout this study so that the resulting reserve figures may be considered as the minimum known recoverable coal reserves. Therefore, the total known recoverable reserves of coal in the Whitwell Shale in Southern Tennessee as of January 1, 1979, are 377,385,000 tons based on the above criteria considered with recovery factors of 50% for underground mining and 80% for strip mining. The Sewanee seam contains the largest part of these reserves totaling 312,665,000 tons. The largest reserves in any Southern Tennessee county are in Sequatchie County with 86,580,000 tons. The reserves in this area are ample for the future, and are much larger than previously estimated.

17370 Kapuni sandstones from Inglewood-1 well, Taranaki: petrology and the effect of diagenesis on reservoir characteristics. Hill, P.J.; Collen, J.D. (BP (Oil Exploration) Company of New Zealand, Ltd., Wellington, New Zealand). *N.Z. J. Geol. Geophys.;* **21**: No. 2, 215-228(1978).

All the important known hydrocarbon reserves of New Zealand are contained in Upper Eocene sandstones of the Kapuni Formation. Despite its economic importance the Kapuni Formation has received little petrological study. This article presents information from ten samples from a 7.5 m cored interval in the Inglewood-1 well, Taranaki. The available sediments are very coarse to medium grained quartzose sandstones with grain supported texture. Dominance of unstrained monocrystalline quartz, limited amounts of microcline and orthoclase, lack of plagioclase, and low mafic content suggest an alkali granitic provenance. Deposition of the sediments as point bars in migrating channels is suggested by the general decrease in grain size upwards and by the sequence of sedimentary structures resembling those described from Recent point bars. Angularity of grains and presence of some fresh feldspar and micas indicate first cycle deposition. Important and widespread diagenetic effects include syntaxial quartz overgrowths, kaolinitization and calcite cementation, all of which have drastically reduced pore space, impaired permeability, and decreased the reservoir potential of the sandstones. Aggradation of detrital kaolinite and precipitation of quartz overgrowths from pore waters supersaturated with silica probably began soon after deposition. Carbonic and humic acids produced during early coalification probably aided solution of alumina, hydrolysis of feldspars, and precipitation of kaolinite.Later, chemical changes during the increase in rank to bituminous coal would have raised pore water pH, resulting in the deposition of calcite. Other late diagenetic effects were etching of overgrowths and reaction between calcite and silica. The emplacement of methane would have stopped chemical diagenesis. 17 figures.

MINING

REFER ALSO TO CITATION(S) 17364

17371 Impact of coal development on wildlife: an economic analysis. Brookshire, D.S.; Eubanks, L.S.; Rowe, R.D.; Livingston, D.B. (Univ. of Wyoming, Laramie). pp 480-486 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper presents results which give a basic feel for the economic consequence of reduced wildlife population due to increased mining activity. They must, however, be qualified by the limitation of the hedonic approach. For example, the approach ignores the possibilities of hunters substituting areas as populations decrease. This tends to bias the estimates upward. On the other hand, the approach underestimates the valuations due to the omission of option and existence values; i.e., even if one does not hunt, there still may be a value associated with the existence or option on future existence of the specie. If the loss of a species is irreversible, such omitted valuations are potentially large. The results presented here indicate the economic loss associated with small changes in wildlife populations and may well be offset by benefits from coal development. As yet the findings are too tentative and subject to limitations to make policy implications regarding large scale reductions or elimination of wildlife populations in the west.

17372 Streamflow effects resulting from surface mining in the Powder River Basin. Hasfurther, V.R.; Rechard, P.A. (Univ. of Wyoming, Laramie). pp 525-530 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The Water Resources Research Institute (WRRI) at the University of Wyoming has been making streamflow and water quality measurements on a number of ephemeral streams within the surface coal producing areas of the Eastern Powder River Basin in Wyoming. This paper discusses the existing data base for three mines spaced throughout a 60 mile reach and indicates the trends which are occurring in streamflow and water quality.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 17321, 17343, 17344, 17345, 17367

17373 Methods of and apparatus for cleaning coal. Smith, C.D.; Keller, D.V. Jr. (to Otisca Industries, Ltd.). US Patent 4,173,530. 6 Nov 1979. Filed date 24 Mar 1975. 56p.

Methods of and apparatus for cleaning coal in which fluorochlorocarbons are used as parting liquids. Various novel techniques, components, and combinations thereof are employed to maximize efficiency; to minimize costs and adverse environmental impacts; to make it possible to recover coal of a character which has heretofore been economically unrecoverable; to produce a superior product; and to reach other worthwhile goals.

17374 Method of filtering molten coal. Mueller, H. (to Chemap AG). US Patent 4,157,305. 5 Jun 1979. Priority date 20 Jun 1975, Switzerland, 8p.

A process for filtering molten coal is provided. The process comprises the steps of providing a filter, passing a stream of molten coal which includes some solid material against the filter and filtering the solid material so as to form a filter cake on and to pass a filtrate through the filter, directing a stream of inert gas against the filter cake so as to dry the same to a predetermined low moisture content, centrifuging the dried filter cake off the filter, separating from the filter cake a fraction composed of fine particles, adding the separated fine particles to a stream of molten coal upstream of the filter, and passing the stream of molten coal and separated fine particles against the filter. The fine particles act as a filter aid for the filtration of the molten coal. The process can also comprise adding calcium oxide or an inorganic salt to a stream of molten coal whereby the added compound acts as a filter aid, and subsequently recovering the added compound and again adding it to a stream of another coal.

17375 Environmental impacts of coal transportation and storage. Martin, J.F. (Environmental Protection Agency, Cincinnati, OH). pp 218-222 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article deals with the subjects of coal transport and storage which have recently become active areas of concern for the US Environmental Protection Agency (EPA). Projects in these fields have been supported by EPA and the Extraction Technology Branch (ETB) for approximately two years. The energy/environmental studies now conducted by the Industrial Research Laboratory, Cincinnati, Ohio, include eastern underground coal mines, eastern surface coal mines, western coal mines, treatment of mine drainage, oil shale extraction, uranium mines, and transportation of solid fuels.

17376 Computer simulation of coal preparation plant performance. Jacobsen, P.S. (Colorado School of Mines Research Inst., Golden). pp 277-284 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper describes the first phase of a computer program, developed under the joint sOonsorship of the US Environmental Protection Agency and the US Bureau of Mines, that simulates the performance of coal preparation plants with exclusive reference to crushing, screening, and cleaning. The simulator accommodates 30 units, 25 flow streams, and 3 retreatment streams interconnected at the option of the user. Twenty-two size increments of coal and 10 specific gravity fractions are permitted. Output data include a summary table for each unit and an overall summary table for the entire plant giving in each table weight, ash, sulfur forms, Btu, and sulfur oxide emission data. As applicable, standard coal preparation efficiency and performance criteria are presented. The user inputs raw-coal feed washability and specifies the type of equipment and control parameters desired. The computer program is thus able to assess the sulfur and ash reduction potential of various coals, to evaluate various coal preparation plant operating parameters, as well as to evaluate completely separate plant flowsheets. An example is presented of a Baum jig plant producing a primary product and a middling product. The latter product after crushing, is retreated on a concentrating table. Froth flotation treats the fine size fraction. Concluding remarks outline a proposed second phase computer program which would include the modeling of dewatering and thickening devices, liberation of impurities upon crushing, plant Btu recovery optimization, and capital and operating cost economics.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 17367

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 17362, 18072

17377 (UCRL—52893) Glove permeation by shale oil and coal tar extract. Nelson, G.O.; Carlson, G.J.; Buerer, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1980. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

The vapor penetration of shale oil and coal tar extract through protective gloves composed of either polyethylene, polyvinyl chloride, vinyl, latex, neoprene, Buna-N, acrylonitrile, natural rubber, or nitrile rubber was tested and measured. We used flame ionization techniques to determine the permeation characteristics of the gloves. Neoprene, Buna-N, acrylonitrile and nitrile gloves offered the best protection against the vapors tested.

PETROLEUM

17378 (NP—24327) Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V. Annual report, 1978. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.)). 1979. 156p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

In its annual report 1978, the Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie (DGMK) gives a general survey of the variety of the problems it deals with in several scientific branches. Generally, the performance is seen as successful. In the research program, the reciprocieties between several branches could be taken more into consideration by plans supplementing one another. By means of some larger projects, the DGMK intensified the cooperation with the research-supporting ministries, esp. the Fed. Min. of Research and Technology. With other scientific societies it discussed a closer adapting of the programs. These efforts brought a visible success, due to the agreement to hold joint meetings every other year in the future with the Special Team, Lubricants and Their Application, and the Gesellschaft fuer Tribologie. Effective 1 July 1978, the DGMK was incorporated in the Working Group of Industrial Research Associations. Discussions concerning a cooperation took place with the Industrial Association of Petroleum and Natural Gas Production and the Association of Chemical Industry. The DGMK expanded its international contacts within the frame of the European Petroleum Technical Cooperation and with Stichting Concave. The cooperation with the German Institute for Standardization which had proven good was guaranteed by an agreement with the Commission on Petroleum and Fuel Standardization. Furthermore, the DGMK participated in the preparation of the guidelines of the VDI-Commission on keeping the air clean.

RESERVES

17379 Petroleum, natural gas, and shale resources of the United States. Foster, R.B. Chicago, IL; Institute of Gas Technology (1980). 7p. (CONF-800210—2).

From IEEE Region 6 conference; San Diego, CA, USA (20 Feb 1980).

Domestic reserves of crude oil appear to have been well explored and promise to provide only slowly declining production rates, although discovery of one or more super-giant fields might provide some temporary relief. The recent increases in crude oil prices have reached a level that will permit the commercial production of oil from shale to proceed. The extensive reserves of both Western (Colorado) and Eastern Devonian shale are discussed. These resources are larger than the oil resources of the Middle East. Their production rate is not dependent on the magnitude of the reserves but upon our ability to extract the oil in an environmentally acceptable way at costs competitive with other sources. The increasing prices allowed for natural gas at the wellhead have focused

attention on extensive domestic natural gas reserves, not attractive at historic prices, that may yield significant amounts of natural gas under the price incentives now available. The various potential new sources are described, and their potential contributions assessed.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 17566, 18093

17380 (METC/EGSP—101) **Oil and gas shows in Devonian black shales and interbedded units in New York as of January 1978.** Peterson, J.C.; Van Tyne, A.M. (New York State Museum and Science Service, Albany (USA)). 1978. Contract EY-76-S-05-5206. 90p. Dep. NTIS, PC A05/MF A01.

Two maps are included. (DLC)

17381 (METC/EGSP—102) **Oil and gas fields in New York as of July 1978.** Peterson, J.C.; Van Tyne, A.M. (New York State Museum and Science Service, Albany (USA)). 1979. Contract EY-76-S-05-5206. 90p. Dep. NTIS, PC A05/MF A01.

Two maps give the locations of oil and gas fields in New York State. (DLC)

17382 (SAND—79-2390) **DEEP STEAM Project. Quarterly report, July 1-September 30, 1979.** Fox, R.L.; Johnson, D.R.; Donaldson, A.B.; Mulac, A.J.; Eisenhawer. S.W. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

Objective of Project DEEP STEAM is to develop the technology required to economically produce heavy oil from deep reservoirs. Accomplishments attained during this reporting period include: completion of construction and initiation of testing in the thermal well completions test tower at Tacoma, WA; finalizing a testing agreement for field evaluation of a high pressure combustion downhole steam generator; successful laboratory testing of a combustion wave ignition system for low pressure combustion downhole steam generator; completion of atmospheric combustion test of diesel-fueled high pressure combustor; and initiation of a program for minimum stress packers.

17383 **Arctic drilling and production platform.** Schirtzinger, J.F. (to Sea-Log Corp.). US Patent 4,170,187. 9 Oct 1979. Filed date 26 Jan 1978. 4p.

A mobile drilling and production platform for arctic regions is described in which a hull having a deck forming the production platform is supported on a first set of parallel runners secured to the underside of the hull and extending fore and aft with spaces between the runners. A second set of parallel segmented runners are secured to the underside of the hull and extend perpendicular to the first set of runners, the second set of runners including plurality of sections positioned in the spaces between the first set of runners. A plurality of rotating ice cutters are mounted on the hull and extend down in front of the ends of each of the runners, the ice cutters cutting channels in the ice in which the runners move and support the hull. One set of runners is vertically movable from the hull relative to the other set of runners whereby the weight of the hull can be transferred from one set of runners to the other to permit movement of the platform along two perpendicular axes or coordinance of motion.

17384 **Guidelineless subsea wellhead entry/reentry system.** Thorne, P.M. (to FMC Corporation). US Patent 4,167,215. 11 Sep 1979. Priority date 26 Feb 1977, United Kingdom of Great Britain and Northern Ireland (UK), 14p.

A guidelineless subsea wellhead system includes TV/sonar guidance components which direct operating and/or service equipment into a position adjacent a subsea wellhead. An offset funnel mounted on the wellhead is used to guide a probe, which is mounted on a riser, into alignment with the wellhead. The probe is used to guide the riser and the service equipment into exact alignment with the wellhead so that tasks such as well entry, tree installation, well reentry, tree cap removal, tree cap replacement and downhole wireline operations can be completed without any cable guidelines. The system can also be used with the usual guidelines to increase the speed and accuracy of connecting to the wellhead.

17385 **Oil well pumping tube drain device.** Huckaby, L.L. US Patent 4,166,715. 4 Sep 1979. Filed date 13 Mar 1978. 8p.

A specially designed valve is incorporated in the pumping tube of an oil well pump secured to the lower end of an oil well pipe string. In pumping the well, oil is drawn up through the pumping tube and oil pipe string to the surface. The check valve is arranged to be actuated from the surface of the well in response to lowering the sucker rods for operating the pump beyond the normal amplitude limits to thereby place into communication the oil in the pumping tube and pipe string with the annulus of the well between the well casing and exterior walls of the pumping tube pipe string thereby equalizing the hydrostatic pressure and permitting pulling of the well pipe for pump servicing or other operations.

17386 **Surface control well safety valve.** Watkins, F.E. (to Camco, Inc.). US Patent 4,160,484. 10 Jul 1979. Filed date 16 Jan 1978. 6p.

A well safety valve for controlling the fluid flow through a well tubing in which the valve is biased closed is described. When fluid control pressure is supplied from the well surface, the valve is opened, but the valve closes when the control pressure exceeds a predetermined value. The tubular member controlling the actuation of the valve member includes a first upper and a second lower telescoping section with releasable locking means normally securing the telescoping sections together. A stop shoulder is positioned in the path of movement of the second section in the opening direction for actuating the release of the locking means when the control fluid force exceeds the predetermined value, and the second telescoping section is moved in a closing direction for closing the valve member when the locking means is released. The locking means may be either a shear pin or a resettable lock.

17387 **Method of and apparatus for squeeze cementing in boreholes.** Owen, H.D.; Rosenthal, W.O. (to Pengo Industries). US Patent 4,158,388. 19 Jun 1979. Filed date 20 Jun 1977. 12p.

A well tool system is described that includes a device for downhole suspension by means of conduit for engaging and penetrating the casing wall of a wellbore and introducing a fluid into the adjacent penetration. The downhole device includes an expansion piston that extends with sufficient force to seal at least one end of the device against a wellbore casing of relatively large diameter. A projectile is subsequently fired from the device to penetrate the engaged casing and provide a selected path of egress for squeeze cementing or the like therethrough. Thereafter, the device is released from its fixed position in the wellbore by retraction of the piston and retrieved therefrom. The device is disclosed with the expansion piston and method of operation therefor shown and described in several embodiments including explosive and hydraulic actuated mechanisms.

PROCESSING

17388 **Mixed-phase reaction product effluent separation process.** Scott, N.H. (to UOP Inc.). US Patent 4,159,937. 3 Jul 1979. Filed date 30 Aug 1978. 10p.

Multiple-stage separation of a mixed-phase product effluent resulting from the hydrocracking and/or hydrorefining conversion of a hydrocarbonaceous charge stock is described. Reaction product effluent is initially separated in a high temperature, high pressure first separation zone, the vapor phase from which is cooled and separated in a second separation zone to provide a hydrogen-rich vaporous phase. The liquid phase from the second separation zone is increased in temperature and separated in a third separation zone at a substantially lower pressure. At least a portion of the liquid phase from the third separation zone is combined with the vaporous phase from the first separation zone prior to cooling and separation in the second separation zone. A savings of about 10.0% in hydrogen loss is realized or about 12 standard cubic feet per barrel of charge stock.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 17394

MARKETING AND ECONOMICS

17389 (LA—8263-MS) **Pre-sale evaluations on Federal offshore hydrocarbon leases.** Bruckner, L.A.; Goldman, A.S.; Montoya, A.F. (Los Alamos Scientific Lab., NM (USA)). Mar 1980. Contract W-7405-ENG-36. 47p. Dep. NTIS, PC A03/MF A01.

Since 1968 the US Geological Survey has been setting pre-sale values on tracts offered for lease on the Outer Continental Shelf. Results of a study of the behavior of these values in relation to the number and size of bids received and the subsequent production are reported here. It is seen that pre-sale values, number of bids, high bid, average bid, and production generally all increase together. While attempts to quantify these relationships as part of a unified theory applicable from sale to sale have not been successful, log-log regression fits resulted in similar models for many of the sales. Two remarkable sales were also discovered - they had almost perfect linear relations between log bids and log pre-sale values.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 17360, 17961, 17962, 17963, 17964, 17965, 17967

ENVIRONMENTAL ASPECTS

17390 Possible impact of significant deterioration regulations on electrical generation capacity additions. Hougland, E.S.; McLeod, D.L. (Tennessee Valley Authority, Chattanooga). pp 194-199 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The feasibility of using mathematical programming to investigate the limit to the total capacity additions that PSD regulations create and to maximize this limit has been demonstrated. In an operational model, the situations avoided in the example by the use of simplifying assumptions must be considered. In practice, the physical characteristics of a generating plant are functions of the designed generating level. In addition, the generating units are available only in certain capacities. To account for this, what are now constants in the constraint equations would become non-linear, and possibly discontinuous, functions of individual unit generation. The model should be able to automatically reject generating capacities too small to be economical. In the example this was done manually. The provisions of the Clean Air Act which allow the increments to be exceeded, especially the variance allowing eighteen days of violation, should be included in the model. Meteorological and air quality monitoring data for the specific study area must be used. This will account for the possibility that the historical worst case conditions are usually not the same for different wind directions. This will also take care of the situation in which a high baseline air quality value decreases the amount of PSD increment available to the difference between the baseline and the ambient air quality standard. The impact of nonattainment area regulations should also be considered in this model. Work is continuing in the development of this model for determination of the effects of PSD regulations upon utility expansion plans. Future developments will be reported.

17391 Final Environmental Statement: crude oil transportation systems proposed by Northern Tier Pipeline Company; Kitimat Pipe Line Ltd.; Northwest Energy Company; Trans Mountain Oil Pipe Line Corporation. Summary. Washington, DC; Bureau of Land Management ([nd]). 83p. (NP—24335).

Portions of document are illegible.

The efficient utilization of Alaskan north slope (ANS) crude oil by construction of a pipeline to the northern tier states is discussed. The environmental impacts of the proposed pipeline system and the capability of minimizing these risks resulting from the transportation of crude oil are included. The design, operation, and the construction aspects are also included. (DC)

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 17391

17392 Petroleum storage and transportation capacities. Volume II. Inventory and storage. Washington, DC; National Petroleum Council (1979). 72p. (NP—24367).

The National Petroleum Council conducted a survey of those companies that report primary inventory data to DOE. The Inventory and Storage Task Group was requested to determine the minimum operatng level of petroleum inventories (that is, the inventory which is required to fill pipelines and tank bottoms as well as maintain minimal operational flexibility and is unavailable in an emergency); the total primary storage capacity for the US and that portion of storage capacity which is required for normal operations and could not be used to store petroleum for an emergency; and the capacity of storage facilities under construction. Additionally, the Task Group was requested to describe the nature of the relationships between primary, secondary, and consumer storage; provide an explanation of the nation's petroleum distribution system; and discuss the Federal government Strategic Petroleum Reserve. It has been concluded from the survey that the minimum operating inventories for crude oil and crude products are: crude oil, 290 million barrels; gasoline, 210 million barrels; kerosine, 35 million barrels; distillate fuel oil, 125 million barrels; and residual fuel oil, 60 million barrels. The amount of tankage capacity in the primary distribution system and the amount of that tankage which could be used to hold petroleum for use in an emergency are summarized. (MCW)

17393 Petroleum storage and transportation capacities. Volume I. Executive summary. Washington, DC; National Petroleum Council (1979). 68p. (NP—24361).

This report provides detailed data on the storage and transportation of oil and natural gas to assist those responsible for emergency preparedness planning, but it does not attempt to analyze various hypothetical emergency situations. The report includes data on liquefied petroleum gas (LPG) only in specifically identified transport facilities. The logistical and inventory segments of the petroleum industry are ever changing. The system capacities presented in the report are those that existed within the primary petroleum distribution system at a fixed point in time. The method by which petroleum inventories are stored and transported is an integrated and highly complex logistical process within which crude oil, petroleum products, and natural gas are moved from extraction and manufacturing to the customer. It is important that the reader understand that the various components of this primary system do not exist in isolation: rather they function only as part of the very much larger US and foreign petroleum and natural gas industry. Therefore, attempts to extrapolate from the data in this report may result in invalid conclusions. The report consists of six volumes: Volume I - Executive summary; Volume II - Inventory and storage report; Volume III - Petroleum pipeline report; Volume IV - Tank cars/trucks report; Volume V - Waterborne transportation report; and Volume VI - Gas pipeline report. Volumes II through VI provide full details of the report. Included within each volume are data requested by the Secretary and an overview providing background information on industry operations. Each volume also contains a glossary of terms used in the report, a description of the report methodology, and appropriate maps, tables, charts, and graphs.

STORAGE

REFER ALSO TO CITATION(S) 17392, 17393

17394 (DOE/EV—0032) Report on the explosion, fire, and oil spill resulting in one fatality and injury on September 21, 1978, at Well 6 of Cavern 6 at the West Hackberry, Louisiana, oil storage site of the strategic petroleum reserve. Volume I. (Department of Energy, Washington, DC (USA)). Nov 1978. 534p. Dep. NTIS, PC A23/MF A01.

The following report is the independent product of the Accident Investigation Committee which was commissioned by the Department of Energy following the accident on September 21, 1978, at the Strategic Petroleum Reserve site at West Hackberry, Louisiana. This Committee is charged with the task of determining the nature, extent, and causes of that accident, which resulted in loss of life, injury and property damage, and the need for corrective action. A nonburning oil spill went into nearby Black Lake, but was contained by the deployment of a series of oil spill containment booms and a prevailing wind from the northeast that kept the oil spill in a restricted area near shore. Because of the rapid and effective containment and cleanup of the oil spill by the Rapid Response Team, it appears very likely at this time that Black Lake will not sustain any permanent environmental damage. Cavern 6 initially contained approximately 7,000,000 barrels of oil at a pressure of 650 psig measured at the well head. As of September 29, 1978, the Strategic Petroleum Reserve Office - New Orleans (SPRO) estimated that oil expulsion from Cavern 6 was 67,510 barrels. Of this, 34,620 barrels of oil are accounted for, including 31,200 barrels of oil released into Black Lake and subsequently recovered. The remainder (32,890 barrels) was assumed by SPRO to have been burned. The total loss is presently estimated by the Accident Investigation Committee 's consultant to be $12 million. An assessment of the technical problems present at the time of the accident is given. Recommendations for improved safety procedures are included.

17395 (SAND—80-0096) Strategic petroleum reserve (SPR) geotechnical program management and program plan: Issue B. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 49p. Dep. NTIS, PC A03/MF A01.

The geotechnical program will provide a sufficiently comprehensive, site-specific data base to support the planning, design, construction, and operation of the SPR crude-oil storage facilities. These data will be used in assessing the long-term stability of SPR storage caverns and mines to minimize the potential for cavity failures which could result in significant environmental impacts, economic losses, or failure to withdraw oil when needed. A long term monitoring plan will be developed which will provide up-to-date information regarding cavern or mine condition and the quantity, quality, and recoverability of the stored crude oil. The interim technical support for leaching will include an extensive review of existing leach/fill plans and development of alternative plans including leach only, followed by oil fill.

COMBUSTION

17396 Water-in-oil emulsion firing in an industrial steam boiler. Cook, T.D. Sr. (General Motors Corp., Warren, MI). pp 415-420 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses GM experience with a water-in-oil emulsion system in the laboratory and during testing of a 100,000 pound per hour steam boiler converted from coal to number 6 oil. The system, installed in an existing oil-fired powerhouse, requires a minimum of piping change and no change with regard to burners, pumps and heaters. A variety of efficiency and economic improvements is discussed.

17397 (LIB-tr—4844) **Pneumatic atomization of oil by natural gas. Technical Note No. 22.** Translated from *Rev. Gen. Therm.;* 202: No. 10, 781-791(1978). 22p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In order to facilitate the ignition of certain liquid combustibles, they are atomized at the entry of the combustion chamber. Two methods are used for this purpose: mechanical atomization which involves passing the liquid under strong pressure through calibrated orifices of small diameter; and pneumatic atomization which uses the expansion of a pre-compressed auxiliary fluid. Traditionally, air or steam was used for this purpose. Natural gas, generally available under high pressure, constitutes for many reasons the most interesting atomization fluid. Atomization by compressed air and by natural gas is discussed.

NATURAL GAS

RESERVES

REFER ALSO TO CITATION(S) 17379

GEOLOGY AND EXPLORATION

17398 (MLM-ML—78-44-0001) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, January 1-March 31, 1978.** Zielinski, R.E. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 170p. (MLM-EGSP-TPR-Q—005). Dep. NTIS, PC A08/MF A01.

Geochemical analyses were initiated on the samples from the Mason County, West Virginia well. C_1-C_7 analyses indicated that the samples were gas rich. Detailed hydrocarbon analyses were completed on samples from the R-109 well in Washington County, Ohio and the OH-1 well in Carroll County, Ohio. Material Balance Assays were completed for the VA-1, I-2, R-109, OH-1, S-1-28, and OH-2 wells. Pyrolysis-GC Analysis has been completed on samples from the 0-1, VA-1, R-109, OH-1, and S-1-28 wells. The data are supportive of the Material Balance Assay. Gross lithology has been completed on samples from the R-109, OH-1, S-1-28, and WV-5 wells. Results for the R-109, OH-1 and WV-5 wells indicate that the samples are 100% shale. The results for the S-1-28 well, however, indicate dolomite dominance in the interval from 1500 to 1580 feet.

17399 (MLM-ML—79-43-0004) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, January 1-March 31, 1979.** Zielinski, R.E.; Nance, S.W. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 172p. (MLM-EGSP-TPR-Q—009). Dep. NTIS, PC A08/MF A01.

This report contains the characterization results of cored shale samples from the IND-2 (Clark County, Indiana) and WV-7 (Wetzel County, West Virginia) wells. Select results are also reported for shales from wells WV-5 (Mason County, West Virginia) and NY-1 (Allegany County, New York). Other wells in other states are also covered.

17400 (MLM-MU—78-68-0001) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1978.** Zielinski, R.E. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 256p. (MLM-EGSP-TPR-Q—006). Dep. NTIS, PC A12/MF A01.

Biostratigraphic analysis of samples from wells R-109, OH-1, and WV-5 has been completed. The samples from the R-109 well are Upper Devonian, Famennian or Frasnian Stages. The samples from the OH-1 and WV-5 wells range from the Middle Devonian, Givetian Stage to the Upper Devonian, Famennian Stage. The depositional environment of the R-109 well is non-marine with a restricted marine transition in the middle of the well. A regressive pattern of marine overlain successively by restricted marine and non-marine was observed in the OH-1 well. The basal sections of the WV-5 well are dominated by restricted marine deposition with a greater influence of non-marine sediments at the shallower depths. The following information is reported: organic carbon content results; lithologic description; vitrinite reflectance analysis; elemental analysis of kerogen; visual assessment of kerogen; mineralogical results; sedimentation studies; elemental analysis; detailed hydrocarbon analysis; material balance assay results; C_1-C_7 results; permeation studies; scanning electron microscopy studies; geophysical studies results; statistical analysis results; mechanical testing results; and shale block fracture analysis.

17401 (MLM-MU—78-70-0003) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, July 1-September 30, 1978.** Zielinski, R.E.; Nance, S.W. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 145p. (MLM-EGSP-TPR-Q—007). Dep. NTIS, PC A07/MF A01.

Shale samples from the WV-6 well (Monongalia County, West Virginia) were the primary source of the geochemical results reviewed in this report. Shale cuttings were obtained from ~ 2000 to 7200 ft; shale core, 7200 to 7600 ft. The sampling interval was every 10 ft from the cored section. These shales were Upper Devonian and Early Mississippian in age. They were primarily deposited within a non-marine environment. The mean organic carbon content was 1.85 wt %. This value is within the range of mean values of 1% to 2% for other Appalachian Basin shales previously reported in the Mound Facility EGSP studies. Within the cored interval, the shales were generally slightly silty, slightly calcareous to non-calcareous, blocky, fissile, and hard. Both the vitrinite reflectance and kerogen coloration results indicate WV-6 shales are very thermally mature. The following data are presented: organic carbon content; lithology; thermal maturation results; elemental kerogen analysis; kerogen analysis; bitumen analysis; saturate hydrocarbon analysis; material balance assay; pyrolysis-GC analysis; sedimentation analysis; scanning electron microscopy studies; laser pyrolysis;shale permeation studies;offgassing studies; shale physical properties studies; and geophycial studies.

17402 (MLM-MU—78-72-0003) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1-December 31, 1978.** Zielinski, R.E.; Nance, S.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound Facility). 1978. Contract EY-76-C-04-0053. 128p. (MLM-EGSP-TPR-Q—008). Dep. NTIS, PC A07/MF A01.

On shale samples from the WV-6 (Monongalia County, West Virginia) well, mean total gas yield was 80.4 ft^3/ton. Mean hydrocarbon gas yield was 5.7 ft^3/ton, 7% of total yield. Methane was the major hydrocarbon component and carbon dioxide the major nonhydrocarbon component. Oil yield was negligible. Clay minerals and organic matter were the dominant phases of the shale. Illite averages 76% of the total clay mineral content. This is detrital illite. Permeation of methane, parallel to the bedding direction for select samples from WV-5 (Mason County, West Virginia) well ranges from 10^{-4} to 10^{-12} darcys. The permeability of these shales is affected by orgaic carbon content, density, particle orientation, depositional facies, etc. Preliminary studies of Devonian shale methane sorption rates suggest that these rates may be affected by shale porosity, as well as absorption and adsorption processes. An experimental system was designed to effectively simulate sorption of methane at natural reservoir conditions. The bulk density and color of select shales from Illinois, Appalachian and Michigan Basins suggest a general trend of decreasing density with increasing organic content. Black and grayish black shales have organic contents which normally exceed 1.0 wt %. Medium dark gray and gray shales generally have organic contents less than 1.0 wt %.

17403 (MLM-MU—79-66-0006) **Physical and chemical characterization of Devonian gas shale. Quarterly status report, April 1-June 30, 1979.** Zielinski, R.E.; Nance, S.W. (Mound Facility, Miamisburg, OH (USA)). 1979. Contract EY-76-C-04-0053. 513p. (MLM-EGSP-TPR-Q—010). Dep. NTIS, PC A22/MF A01.

Geochemical characterization data was obtained primarily for samples from wells NY-1, WV-7, IND-2, I11-4, KY-4, PA-1, PA-2, and OH-3.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 17380, 17381, 17384, 17387

HEALTH AND SAFETY

17404 (UCID—18576) **LLL data acquisition system for liquified gaseous fuels program.** Baker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Mar 1980. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

A data acquisition system is being developed by EG and G, Inc., and the Electronics Engineering Department of LLL for use during upcoming liquefied natural gas (LNG) dispersion tests. The system will employ 51 battery-powered complementary metal-oxide semiconductor (CMOS) data acquisition units to measure gas concentration, wind direction and speed, temperature, humidity, and heat flux. Data acquired by the CMOS data acquisition units will be telemetered via UHF radio links to a trailer-based microcomputer command, control, and data recording system (CCDRS). In the CCDRS, wind data will be displayed graphically. All data will be recorded on disk units for subsequent analysis at the Livermore time-sharing system computer facility.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 17389

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 17393

STORAGE

REFER ALSO TO CITATION(S) 17393

OIL SHALES AND TAR SANDS

17405 (DOE/TIC—3378) **Oil shales: selected bibliography of DOE sponsored research.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jan 1980. 128p. Dep. NTIS, PC A07/MF A01.

Four hundred thirty-six citations of reports, journal articles, patents, conference papers, and monographs resulting from Department of Energy sponsored research on oil shales are presented. These citations and approximately 8000 additional citations are a part of the Department of Energy's Energy Information Data Base. The citations are arranged by subject category. Within the categories references to reports are listed in alphanumeric order by report number. Other citations follow in inverse chronological order. Five indexes are provided: Corporate, Author, Subject, Contract Number, and Report Number.

17406 (LETC/RI—80/3) **Bibliography of publications dealing with oil shale and shale oil from US Bureau of Mines, 1917-1974; the ERDA Laramie Energy Research Center, 1975-1976; and the DOE Laramie Energy Technology Center, 1977-1979.** (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Feb 1980. 62p. Dep. NTIS, PC A04/MF A01.

A brief history is given of the oil-shale research programs conducted by the Bureau of Mines and then the Laramie Energy Center. The bibliography of approximately 800 references is arranged alphabetically by author under each year of publication. (DLC)

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 17379

SITE GEOLOGY

REFER ALSO TO CITATION(S) 17399, 17400, 17401, 17402, 17403

DRILLING, FRACTURING, AND MINING

17407 **Method of using a low temperature freezing softening and abrasion fluid.** Eller, S.A. US Patent 4,167,292. 11 Sep 1979. Filed date 22 Nov 1977. 16p.

A low temperature freezing fluid and method are used for year-round wearing away of bitumen deposits, such as those of the Athabaska Tar Sands, by a softening and/or abrasion process. Relatively small size particles of bitumen and its associated foreign matter are produced which enable separation of bitumen at greater speed, efficiency and thoroughness than present methods. Water solutions of calcium chloride having a freezing point down to -46° F and a specific gravity greater than that of bitumen are used as the fluid. Since bitumen deposits vary considerably in physical properties; optimum softening and/or abrasion efficiency and reduced particle size are achieved by either heating the fluid to 212°F to soften or refrigerating it to - 46°F to harden the bitumen prior to spraying it at high velocity onto the deposit. At times, faster rates of softening and/or abrasion and reduced particle size are achieved by incorporating abrasion particles in the fluid. The fluid conveys bitumen, foreign matter and abrasion particles to a pool from which they are pumped to on site conditioning and separation tanks. After separation into components, bitumen and fluid are combined and pumped to a refinery wherein they are separated and bitumen upgraded to synthetic crude oil. The foreign matter and abrasion particles are pumped together with fluid to either an on site tailings pond or to recycle equipment. The fluid is recycled.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 17413

17408 (UCID—16986-79-4) **Lawrence Livermore Laboratory oil shale project. Quarterly report, October-December 1979.** Rothman, A.J. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 50p. Dep. NTIS, PC A03/MF A01.

Results are reported of Retort run L-4. Evaluation of retort performance from offgas data is being developed. Research is being conducted on the determination of yield from oil analysis and on H_2S evolution. A computer model is being developed for calculating the motion of large numbers of particles, such as rubblized oil shale. (DLC)

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 17338

17409 (LETC—10787-35) **Investigation of the geokinetics horizontal in situ oil shale retorting process. Quarterly report, July-September 1979.** Mankowski, S.G.; Hutchinson, D.L. (Geokinetics, Inc., Concord, CA (USA)). Nov 1979. Contract ET-78-F-03-1787. 236p. Dep. NTIS, PC A11/MF A01.

Drilling of blastholes on Retort 23 was completed. Retort 17 continued to burn, producing 3265 bbl of oil by September 30, at a daily rate of 20 to 30 bbl/d. Post-blast coring of Retorts 20, 21, and 22 was completed. Results of meteorological and soil studies are presented in appendices. 17 figures.

17410 (LETC/RI—80/2) **Effect of oil shale type and retorting atmosphere on the products from retorting various oil shales by the controlled-state retort.** Duvall, J.J.; Mason, K.K. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Feb 1980. 39p. Dep. NTIS, PC A03/MF A01.

Six oil shales from different locations (the Green River formation of Colorado and Utah, the Antrim Basin of Michigan, and Morocco) having different Fischer Assay oil yields were retorted using three retorting atmospheres (N_2, N_2/steam, and N_2/steam/O_2) under the same retorting conditions. The products (oils, gases, waters, and shales) were analyzed and the data are reported. Changing retorting atmospheres had little observable effect on the product oils; however, there was a great deal of change in the composition and amount of gas produced. Steam in the retorting atmosphere increased the amount of carbon dioxide produced and decreased the amount of carbonate and organic carbon in the retorted shale. Addition of oxygen to N_2/steam and increasing the maximum temperature compounded the above effect. 3 figures, 20 tables.

17411 **Recovery of shale oil and magnesia from oil shale.** Hard, R.A. (to Occidental Research Corp.). US Patent 4,171,146. 16 Oct 1979. Filed date 23 Jan 1978. 34p.

A fragmented permeable mass of formation particles containing oil shale and carbonates of calcium and magnesium is formed in an in situ oil shale retort. A combustion zone is advanced through the fragmented mass, whereby kerogen in oil shale in the fragmented mass is decomposed in a retorting zone on the advancing side of the combustion zone to produce gaseous and liquid products including shale oil, and particles containing retorted oil shale are combusted for converting magnesium values to more leachable form such as magnesium oxide. Magnesium values are leached from the combusted particles selectively with respect to calcium compounds and silicates with aqueous solutions of a purgeable, acid-forming gas such as carbon dioxide or sulfur dioxide. An enriched solution containing

magnesium values is withdrawn from the fragmented mass and magnesia is recovered from such enriched solution.

17412 Method of forming an in situ oil shale retort with void volume as function of kerogen content of formation within retort site. Ridley, R.D. (to Occidental Oil Shale Inc.). US Patent 4,167,291. 11 Sep 1979. Filed date 29 Dec 1977. 18p.

An in situ oil shale retort is formed in a subterranean formation containing oil shale. The formation comprises at least one stratum of relatively higher average kerogen content which is included in formation of relatively lower average kerogen content. A void is excavated in a retort site in the formation, leaving a remaining portion of unfragmented formation within the retort site adjacent the void. The portion of unfragmented formation within the retort site is explosively expanded toward the void to form a fragmented permeable mass of formation particles containing oil shale in an in situ retort in which fragmented formation particles from the stratum of higher kerogen content have a larger void fraction than the average void fraction of the fragmented mass. This can be accomplished by enlarging the void in the vicinity of the stratum having the higher kerogen content prior to explosive expansion. When the fragmented mass is retorted, there is no substantial increase in resistance to flow of gas through the fragmented mass due to the relatively higher thermal expansion of fragmented formation particles having the higher kerogen content. 13 claims.

17413 Legal issues in the development of oil shale. Linden, L.H.; Nyhart, J.D. (Massachusetts Inst. of Tech., Cambridge). pp 323-328 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper summarizes the analytical methodology and major results of a study at the MIT Energy Laboratory aimed at identifying and ordering the major legal issues involved in the development of oil shale. The analysis was based on legal, technical, and political data available in mid-1976.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 17398

17414 Dependence of thermal diffusivity on organic content for Green River oil shales: Extension of the modified Cheng-Vachon model to the parallel heat-flow case. Wang, Y.; Rajeshwar, K.; DuBow, J. (Department of Electrical Engineering, Colorado State University, Fort Collins, Colorado 80523). *J. Appl. Phys.;* **51**: No. 3, 1829-1830(Mar 1980).

In an earlier paper [J. Appl. Phys. 50, 2776 (1979)], the modified Cheng-Vachon model was found to give good agreement with experimental data on the variation of thermal diffusivity with organic content for Green River oil shales. Calculations using the model were carried out for the case where heat flows in directions perpendicular to the shale stratigraphic planes. In the present paper, the above model is modified to account for experimental trends in the parallel heat-flow case. The modified model provides a self-consistent explanation for the lower degree of anisotropy (relative to theory) that has been experimentally observed for the thermal diffusivity of Green River oil shales.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 17377

WASTE RESEARCH AND MANAGEMENT

17415 (PNL—3300(Pt.5), pp 35-38) **Environmental control technology for shale oil wastewaters.** Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health, and safety.

The capabilities and limitations of conventional treatment and disposal technology are being evaluated for shale oil wastewaters. Bench-scale treatability studies are being conducted to assess the effectiveness of alternative physical, chemical, and biological processes for removing pollutants from shale oil wastewaters. Toxicity problems previously experienced with aerobic biological treatment of in-situ retort water have been overcome through careful control of pH in the activated sludge aeration units and by a prolonged acclimation period to allow the biological sludge to adjust to the relatively harsh chemical nature of the retort water. Adding powdered activated carbon to the activated sludge units also helped promote biological degradation of both organic and inorganic constituents of the retort water samples tested.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 17771

RESERVES

REFER ALSO TO CITATION(S) 18093

17416 Search for other natural fission reactors. Apt, K.E.; Balagna, J.P.; Bryant, E.A.; Cowan, G.A.; Daniels, W.R.; Vidale, R.J. (Los Alamos Scientific Lab., NM (USA)); Brookins, D.G. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). pp 677-689 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

Precambrian uranium ores have been surveyed for evidence of other natural fission reactors. The requirements for formation of a natural reactor direct investigations to uranium deposits with large, high-grade ore zones. Massive zones with volumes approximately $>1m^3$ and concentrations approximately >20% uranium are likely places for a fossil reactor if they are approximately $>0.6x10^9$ years old and if they contained sufficient water but lacked neutron-absorbing impurities. While uranium deposits of northern Canada and northern Australia have received most attention, ore samples have been obtained from the following world-wide locations: the Shinkolobwe and Katanga regions of Zaire; southwest Africa; Rio Grande do Norte, Brazil; the Jabiluka, Nabarlek, Koongarra, Ranger, and El Sharana ore bodies of the Northern Territory, Australia; the Beaverlodge, Maurice Bay, Key Lake, Cluff Lake, and Rabbit Lake ore bodies and the Great Bear Lake region, Canada. The ore samples were tested for isotopic variations in uranium, neodymium, samarium, and ruthenium which would indicate natural fission. Isotopic anomalies were not detected. Criticality was not achieved in these deposits because they did not have sufficient ^{235}U content (a function of age and total uranium content) and/or because they had significant impurities and insufficient moderation. A uranium mill monitoring technique has been considered where the "yellowcake" output from appropriate mills would be monitored for isotopic alterations indicative of the exhumation and processing of a natural reactor.

17417 (GJBX—53(80)) **Possible variations on the calcrete-gypcrete uranium model.** Carlisle, D. (Bendix Field Engineering Corp., Grand Junction, CO (USA); California Univ., Los Angeles (USA)). 1 Jan 1980. Contract EY-76-C-13-1664. 71p. Dep. NTIS, PC A04/MF A01.

Genetic models and favorability criteria for calcrete and gypcrete uranium deposits based upon Yeelirrie and other occurrences in Western Australia and upon Langer Henirich and others in Namibia-South West Africa are summarized. Viable analogues of these world-class deposits have not yet been found in USA even though several of the favorable conditions occur in the southwest. A principal deterrent to economic concentration has been tectonic instability. But even in the most favorable areas it is not clear that climates have ever been sufficiently similar to that of the valley-calcrete region of Western Australia. Extensive, thick valley (nonpedogenic) calcretes such as those which host the carnotite in Australia and in Namibia have not been documented here. Nevertheless, submarginal occurrances of carnotite have been found in southwestern United States in small bodies of nonpedogenic and mixed pedogenic-nonpedogenic calcrete. Much of the study is based upon occurrences of carnotite-bearing calcrete and calcrete-gypcrete in the Republic of South Africa. Several of these are described briefly. Some reference is also made to new occurrences and to new data on previously described occurrences on the Namib Desert. Possible variations on the Western Australian and Namibia-South West Africa models which are considered are capillary rise of U in solution, addition of new uraniferous sediment over a calcrete, lateral access of U into a pedogenic calcrete, reworking of U from a weekly mineralized pedogenic calcrete or gypcrete into a new or reconstituted calcrete, or into an unrelated environment for fixation of U.

17418 (K/UR—133) **National Uranium Resource Evaluation Program. Hydrogeochemical and stream sediment reconnaissance basic data for Lemmon NTMS Quadrangle, South Dakota.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jan 1980. Contract W-7405-ENG-26. 233p. Dep. NTIS, PC $14.30/MF $3.50.

Results are reported of a reconnaissance geochemical survey of the Lemmon Quadrangle, South Dakota. Field and laboratory data are presented for 565 groundwater and 531 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors are briefly discussed which may be of significance in evaluating the potential for uranium mineralization. The groundwater data indicate that the area which appears most promising for uranium mineralization is located in the southwestern portion of the quadrangle. Groundwater in this area is produced primarily from the Cretaceous Fox Hills Formation where high values were determined for uranium, arsenic, potassium, and silicon and low values for boron, sodium, pH, sulfate, specific conductance, and total alkalinity. The presence of Tertiary ash deposits and the abundance of organics downdip in the permeable Fox Hills Formation could provide a suitable geochemical framework for uranium accumulation. The stream sediment data indicate that the Pierre Shale, Fox Hills, and Hell Creek Formations in the southwestern portion of the quadrangle have the highest potential for uranium mineralization. Sediments derived from these units are high in uranium, aluminum, arsenic, chromium, cobalt, copper, lithium, magnesium, niobium, nickel, phosphorous, scandium, vanadium, yttrium, zinc, and zirconium.

17419 (SAND—78-1759) **Survey of Indian issues in the state of New Mexico relating to uranium mining and milling.** Vandevender, S.G.; Barsumian, L.; Gurbaxani, S.H. (Sandia Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). Nov 1979. Contract EY-76-C-04-0789. 54p. Dep. NTIS, PC A04/MF A01.

(Estimates of Indian uranium resources range from 11 to 50% of the US total resources. About 17% of New Mexico's reserves are known to be on Indian lands. New Mexico has produced almost half of the nation's uranium supply; over half of the known reserves are located within the state. However, the state has virtually no jurisdiction over development of Indian uranium. As a result, economic and environmental impacts on the state are beyond its control. The lack of state and federal control over these impacts is influencing how the Indians federal control over these impacts is influencing how the Indians allow development to proceed. The impacts of Indian uranium development also influence state control of non-Indian uranium development also influence state control of non-Indian reserves. To the extent that these controls affect the availability of uranium concentrate, DOE needs to understand the issues involved. This issue paper identifies some of the related problems for both the Indians and the state and explores the reasons behind them.

17420 (UCRL—52886) **Search for an elusive 4.4-MeV α emitter in uranium minerals.** Dougan, R.J.; Illige, J.D.; Hulet, E.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1979. Contract W-7405-ENG-48. 17p. Dep. NTIS, PC A02/MF A01.

A search for an unidentified 4.4-MeV α-emitter in Belgian Congo pitchblende and uranium raffinates is described, and a history of observations of 4.4-MeV activity over the last 55 years in radiogenic haloes, zinc ores, monazite, thorite, huttonite, ultrabasic and other abyssal rocks, osmiridium, uranium ores, and raffinates of uranium is given. No evidence of excess 4.4-MeV activity was shown in any of the chemically separated fractions investigated. Upper limits for 4.4-MeV α activity in each of four studied samples are given.

17421 Migration paths for Oklo reactor products and applications to the problem of geological storage of nuclear wastes. Cowan, G.A. (Los Alamos Scientific Lab., NM (USA)). pp 693-699 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

Escape of the products from the Oklo reactor proceeds, first, by escape from the uraninite (UO_2) grains and, second, by transport out of the gangue. Escape from the grain by fission recoil accounts for prompt deposition in the gangue of 5-10% of the products. Escape by volume diffusion is very slow. The rate of loss by diffusion was highest during the operating period of the reactor and may have been of the order of 10^{-6} fraction/a for the most volatile elements. The least volatile elements have been retained in the grains. Their diffusion rates are less than $5x10^{-10}$/a. If similar loss rates can be achieved in synthetic uraninite (or thorianite), the overall rate of transport of most reactor products would be sufficiently limited by diffusion to ensure that essentially all the radioactive species would decay in situ. The principal geochemical requirements for a suitable storage site are those that ensure the survival of the UO_2 matrix, particularly that the pH and Eh are similar to the values at Oklo.

17422 Uranium solubilities in the Oklo reactor zones. Duffy, C.J. (Los Alamos Scientific Lab., NM (USA)). pp 229-233 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

It was hypothesized that uraninite grains in the reactor zones at Oklo might show zonation with respect to the isotopic composition of the uranium. A more nearly natural composition might be expected in the rims of such grains since solutions moving into the reactor zones from the undepleted ore zone would carry natural uranium. Several uraninite grains were examined by means of an ion microprobe capable of resolving a rim of 10μm width. Within the approximately 5% precision of the instrument no zoning was detected. The absence of detectable zoning in the isotopic compositions of the uraninite grains might be caused by low solubility of uraninite in the Oklo ore body resulting in insignificant uranium transport. That this is a reasonable assumption is borne out by solubility calculations for uraninite in equilibrium with uranium ions and uranium oxide, hydroxide, and carbonate ions in aqueous solution. These calculations indicate that if O_2 and CO_2 are in equilibrium with the solid assemblage magnetite, haematite, and graphite total uranium molalities in the pH range from 5 to 6.8 are less than 10^{-9}. Under these conditions, and assuming no other important aqueous uranium species, uranium transport would be insufficient to produce observable zoning in the reactor zone uraninite.

17423 U-Pb age ($2.05x10^9$ years) of the Oklo uranium deposit. Gancarz, A.J. (Los Alamos Scientific Lab., NM (USA)). pp 513-520 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

U and Pb isotopic data on ten samples (10 to 100g) 2 to 10m from the borders of the Oklo reactor zones indicate a primary age of $2.05+-0.03x10^9$ years for the Oklo deposit and a secondary age of $0.375+-0.025x10^9$ years. All samples show effects of Pb loss; the average loss is 50%. Both the U-Pb and Pb isotopic data are consistent with a model of a primary $2.05x10^9$ -year age of the deposit, continuous volume diffusion of Pb from uraninite, and either continuous or recent loss of this Pb. In this case the $0.375x10^9$ -year age is an artifact without time significance. Using an average value of $D/a^2 = 3.5x10^{-11}a^{-1}$ this model explains the apparent $1.8x10^9$ -year Pb age observed by other workers. From the $^{208}Pb/^{206}Pb$ data the average U/Th value calculated for the Oklo deposit is approximately 100.

17424 Possible uranium-ruthenium method for the measurement of ore age. Maeck, W.J. (Allied Chemical Corp., Idaho Falls, ID (USA). Idaho Chemical Programs - Operations Office); Apt, K.E.; Cowan, G.A. (Los Alamos Scientific Lab., NM (USA)). pp 535-540 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

A technique has been devised to date Precambrian uranium ore samples by measuring the concentrations of ^{235}U and of ruthenium isotopes that result from the spontaneous fission of ^{238}U. The concentration of the latter depends on (1) the amount of ^{238}U present; (2) the spontaneous fission decay rate; (3) the ruthenium fission yields for ^{238}U; and (4) the duration of spontaneous fission, i.e. the age of the ore. Ruthenium in Precambrian ores has been identified as being from the natural abundance, the spontaneous fission of ^{238}U, and the more variable neutron-induced fission of ^{235}U. The contribution from "common" natural ruthenium is typically $1ppx10^9$ and is determined from the isotopes of mass 96, 98, and 100, which are not produced in fission. The ratio of isotopes of mass 99, 101, 102, and 104 for ^{238}U spontaneous fission has been found to be significantly different from that ratio for ^{235}U neutron-induced fission. Hence, the amount of ruthenium in an ore sample which results solely from ^{238}U spontaneous fission can be determined. Several Precambrian uranium ore samples have been dated using this technique, and the ages compare favourably to values determined by other techniques. The component of ruthenium resulting from neutron-induced fission of ^{235}U varied between about 0 and 40% of the amount from ^{238}U spontaneous fission, and the component of common ruthenium was typically about 10% of the total ruthenium. This uranium-ruthenium technique should complement existing radiogenic dating techniques because it relies on a radiogenic product whose geochemistry is different from that of products or intermediates in the other decay sequences.

17425 Highest temperatures recorded by the Oklo mineral phase assemblages and rock textures. Vidale, R.J. (Los Alamos Scientific Lab., NM (USA)). pp 235-240 of Les reacteurs de fission naturels. Vienna; IAEA (1978).

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

Biotite-bearing pelitic phase assemblages are observed in reactor zones 2 and 5 and up to at least 4 m outside zone 2, indicating a minimum temperature in these regions of about 400°C. Rock textures suggest that still higher temperatures may have been reached within the reactors.

EXPLORATION

17426 (GJBX—28(80)) **Development of data enhancement and display techniques for stream-sediment data collected in the national uranium resource evaluation program of the United States Department of Energy.** Koch, G.S. Jr.; Howarth, R.J.; Carpenter, R.H.; Schuenemeyer, J.H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1979. Contract EY-76-C-13-1664. 236p. Dep. NTIS, PC A11/MF A01.

The objective of this study was to combine statistical, mapping, and geological techniques in order to evaluate and appropriately display geochemical data for the identification of uranium associated halos utilizing the NURE hydrogeochemical and stream sediment reconnaissance data base. A set of computer-based procedures implemented in a time-sharing interactive mode on a Control Data Corporation Cyber 70 and 174 computer was developed. Techniques of data analysis are developed. Results of the data analysis for the Southeastern area, Seguin quadrangle, and Pueblo quadrangle are presented. Conclusions are drawn and recommendations are stated.

17427 (GJBX—55(80)) **Effects of vegetation on the energy and angular distributions of uranium daughter gamma rays at an altitude of 121.9 meters.** Rubin, R.M.; Price, J.H.; Wells, M.B. (Radiation Research Associates, Inc., Fort Worth, TX (USA)). Jun 1979. Contract EY-76-C-13-1664. 146p. Dep. NTIS, PC A07/MF A01.

This work studies the effect of 10-m trees and 1-m ground cover on the gamma-ray angular flux density as a function of energy at 121.9 meters in air. The trees and ground cover were above a sandstone ore body containing 139 ppM U. Ground cover green biomass was varied from 0.494 to 4.942 kg/m^2. Green tree biomass was varied from 3.4 to 102 kg/m^2. Calculations of the energy and angular distribution of the uncollided gamma-ray flux density at a height of 121.9 meters resulting from the radioactive daughters of uranium were also performed. Results are: (1) the angular distribution of gamma rays at 121.9 meters from gamma-ray sources in the ground and air above 0.4 MeV is peaked upward with the ground source gamma rays the principal contributors; (2) the angular distribution of gamma rays from airborne sources is insensitive to trees or ground cover; (3) the ground cover (green biomass $<$ 4.943 kg/m^2) does not affect the results for ground sources; (4) the angular distribution of gamma rays from ground sources decreases with increasing tree biomass; (5) the total flux density above 0.4 MeV decreases by a factor of 1.8 over the range of tree biomass considered (0 to 102 kg/m^2); and (6) all results are directly proportional to the U ore concentration.The spectrum shape above 0.4 MeV was insensitive to the amount of green biomass. Vegetation reduces the flux detected. For the average green biomass found in forests of US, the flux above 0.4 MeV was reduced by a factor of 1.23 over the case where no biomass was present. In US forests, 25, 50, 75, and 100% of the forests had green biomass densities between 0 and 15 kg/m^2, 0 and 35.4 kg/m^2, 0 and 51 kg/m^2, and 122 kg/m^2. The fluxes at 121.9 m height in both the 4π and downward looking 2π detectors reduce by factors of 1.1, 1.23, 1.36, and 2.02 for green biomass densities of 15, 35.4, 51, and 122 kg/m^2. 21 figures, 47 tables.

ENRICHMENT

17428 **Process and apparatus for separating isotopes.** Mourier, G. (to Thomson-CSF). US Patent 4,167,668. 11 Sep 1979. Priority date 7 Sep 1976, France, 8p.

This invention deals with a process of separating isotopes of atomic mass m_1 and m_2 in a plasma. Isotope m_1 is of low concentration and isotope m_2 is dominant. The plasma is submitted to a time constant uniform magnetic field and to an orthogonal high frequency electric field. To facilitate the separation a third isotope of atomic mass m_3 is included in the plasma. The atomic mass m_3 of the third isotope is such that $m_3 = 2m_1 - m_2$ and its concentration is (for all practical purposes) equal to that of the dominant isotope. The frequency of the electric field is adjusted to the value of the cyclotron frequency of the isotope of mass m_1 in the plasma. One thus compensates the polarization of the plasma due to the dominant isotope and increases the tolerance of the process to the natural fluctuations of the plasma. The ions of the isotope 1 are collected at the extremity of the plates on the sides of the apparatus, while those of isotope 2 and 3 are collected on a plate at the end of the apparatus. The invention will find application in the separation of the two isotopes U_{235} and U_{238}.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 17874

17429 (RFP—2939) **AES and XPS study of plutonium oxidation.** Larson, D.T. (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 17p. (CONF-791013—11). Dep. NTIS, PC A02/MF A01.

From 26. national vacuum symposium; New York, NY, USA (2 Oct 1979).

The initial oxidation of plutonium metal at 27°C has been studied using AES and XPS. Initially a clean plutonium surface was prepared by Ar^+ bombardment and 500°C-Ar^+ bombardment heat cycles. Changes occurring in the plutonium Auger electron spectra in the energy range of 40 to 120 eV and the 4f/sub 5/2/, 4f/sub 7/2/ (core levels), and 5f, 7s (valence band) XPS peaks were monitored during oxygen exposure (10 to 1.8 x 10^8 L). Examination of the 4f/sub 7/2/ level revealed two oxidation states which are attributed to a suboxide and PuO_2. The 4f/sub 7/2/ binding energies for the two oxidation states and plutonium metal are 426.1, 424.4, and 422.2 eV, respectively. By taking the Auger ratio [0(511 eV)/Pu(317 eV)], it was observed that oxidation proceeded by two steps. In the first step there was a rapid increase of oxygen with the formation of the suboxide. In the second stage, the 0(511 eV)/Pu(317 eV) ratio was constant with conversion of the suboxide to PuO_2.

17430 (WCAP—9471) **Remote mixed oxide fabrication facility development. Volume 1: reference facility.** Horgos, R.M.; Masch, M.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). May 1979. Contract EY-76-C-06-1830. 670p. Dep. NTIS, PC A99/MF A01.

The general objective of Task 201 is to present a conceptual design of a remotely operated and maintained fuel fabrication facility. This document, the first of three volumes, describes the reference facility as based on the current design of the Westinghouse Recycle Fuels Plant modified to include the objectives of the Fuels Refabrication and Development (FRAD) program. Included are descriptions of the facility design basis and layout, the manufacturing process, and the auxiliary and support services.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 17433, 17458

17431 (ORNL/TM—6648) **Methodology for estimating reprocessing costs for nuclear fuels.** Carter, W.L.; Rainey, R.H. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 30p. Dep NTIS, PC A03/MF A01.

A technological and economic evaluation of reprocessing requirements for alternate fuel cycles requires a common assessment method and a common basis to which various cycles can be related. A methodology is described for the assessment of alternate fuel cycles utilizing a side-by-side comparison of functional flow diagrams of major areas of the reprocessing plant with corresponding diagrams of the well-developed Purex process as installed in the Barnwell Nuclear Fuel Plant (BNFP). The BNFP treats 1500 metric tons of uranium per year (MTU/yr). Complexity and capacity factors are determined for adjusting the estimated facility and equipment costs of BNFP to determine the corresponding costs for the alternate fuel cycle. Costs of capacities other than the reference 1500 MT of heavy metal per year are estimated by the use of scaling factors. Unit costs of reprocessed fuel are calculated using a discounted cash flow analysis for three economic bases to show the effect of low-risk, typical, and high-risk financing methods.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 17435

17432 **Criticality experiments with subcritical clusters of low enriched UO_2 rods in water with uranium or lead reflecting walls.** Bierman, S.R.; Durst, B.M.; Clayton, E.D. (Battelle-Pacific Northwest Labs., Richland, WA). Contract EY-76-C-06-1830. *Nucl. Technol.;* 47: No. 1, 51-58(Jan 1980).

A series of criticality experiments with 2.35 and 4.31 wt.% ^{235}U enriched UO_2 rods in water has provided well-defined benchmark-type data showing that both depleted uranium and lead reflecting walls, submerged in the water reflector, are better neutron reflectors than water alone. For each fuel enrichment, the critical separation between three subcritical, near optimally moderated fuel clusters was observed to increase as either 77-mm-thick depleted uranium or 102-mm-thick lead reflecting walls were moved toward the fuel. The maximum reactivity effect was observed for the depleted uranium with ~ 20 mm of water between the reflecting walls and the fuel region, whereas for the lead, a maximum effect was obtained with essentially no water between the reflecting walls and the fuel region.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 17431

WASTE MANAGEMENT

WASTE PROCESSING

REFER ALSO TO CITATION(S) 17697

17433 (CONF-800211—2(Draft)) **Processes for the control of $^{14}CO_2$ during reprocessing.** Notz, K.J.; Holladay, D.W.; Forsberg, C.W.; Haag, G.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

From International symposium on management of gaseous wastes from nuclear facilities; Vienna, Austria (18 Feb 1980).

The fixation of $^{14}CO_2$ may be required at some future time because of the significant fractional contribution of ^{14}C, via the ingestion pathway, to the total population dose from the nuclear fuel cycle, even though the actual quantity of this dose is very small when compared to natural background. The work described here was done in support of fuel reprocessing development, of both graphite fuel (HTGRs) and metal-clad fuel (LWRs and LMFBRs), and was directed to the control of $^{14}CO_2$ released during reprocessing operations. However, portions of this work are also applicable to the control of $^{14}CO_2$ released during reactor operation. The work described falls in three major areas: (1) The application of liquid-slurry fixation with $Ca(OH)_2$, which converts the CO_2 to $CaCO_3$, carried out after treatment of the CO_2-containing stream to remove other gaseous radioactive components, mainly ^{85}Kr. This approach is primarily for application to HTGR fuel reprocessing. (2) The above process for CO_2 fixation, but used ahead of Kr removal, and followed by a molecular sieve process to take out the ^{85}Kr. This approach was developed for use with HTGR reprocessing, but certain aspects also have application to metal-clad fuel reprocessing and to reactor operation. (3) The use of solid $Ba(OH)_2$ hydrate reacting directly with the gaseous phase. This process is generally applicable to both reprocessing and to reactor operation.

17434 (CONF-800313—3) **Overview of high-level waste management accomplishments.** Lawroski, H.; Berreth, J.R.; Freeby, W.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 14p. Dep. NTIS, PC A02/MF A01.

From Waste management conference; Tucson, AZ, USA (10 Mar 1980).

Storage of power reactor spent fuel is necessary at present because of the lack of reprocessing operations particularly in the U.S. By considering the above solidification and storage scenario, there is more than reasonable assurance that acceptable, stable, low heat generation rate, solidified waste can be produced, and safely disposed. The public perception of no waste disposal solutions is being exploited by detractors of nuclear power application. The inability to even point to one overall system demonstration lends credibility to the negative assertions. By delaying the gathering of on-line information to qualify repository sites, and to implement a demonstration, the actions of the nuclear power detractors are self serving in that they can continue to point out there is no demonstration of satisfactory high-level waste disposal. By maintaining the liquid and solidified high-level waste in secure above ground storage until acceptable decay heat generation rates are achieved, by producing a compatible, high integrity, solid waste form, by providing a second or even third barrier as a compound container and by inserting the enclosed waste form in a qualified repository with spacing to assure moderately low temperature disposal conditions, there appears to be no technical reason for not progressing further with the disposal of high-level wastes and needed implementation of the complete nuclear power fuel cycle.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 17421, 17434, 17455

17435 (IS-M—273) **Issues relevant to nuclear waste canister materials.** Scott, T.E. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 38p. (CONF-800305—7). Dep. NTIS, PC A03/MF A01.

From Corrosion/80 NACE meeting; Chicago, IL, USA (6 Mar 1980).

This paper focuses on the canister as a component of multibarrier systems for the containment and isolation of high-level radioactive wastes and spent fuel from nuclear reactor burning. It provides perspective for the role of canisters in the overall nuclear fuel cycle with special emphasis on the multibarrier concept of waste isolation. Attention is given to the chemical composition of wastes, waste forms, interim storage environments, and geologic isolation repository environments; these will all have to be considered in canister materials selection. In addition, other factors such as mechanical loads, radiation effects, and radioactive decay-heat generation rates are cited. The paper culminates with a summary of the author's opinion of the technical issues which need to be resolved before canisters can be considered viable components of a multibarrier system for geologic waste isolation.

17436 (LA—8088-PR) **Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Annual report, October 1, 1978-September 30, 1979.** Erdal, B.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7505-ENG-36. 91p. Dep. NTIS, PC A05/MF A01.

Extensive studies of the behavior of plutonium and americium in pH ≅ 8 groundwaters were made, particularly with respect to container sorption, filtering, and centrifugation. Significant improvements in the method used for measuring sorption ratios for these elements were developed, and their sorption-desorption ratios on argillite and tuff were measured. Effects of particle size, temperature, sampling location, mineralogy, and time were investigated for these elements. The chemical composition of the water was found to be a major factor that governs sorption behavior. Studies of the sorption of strontion, cesium, barium, cerium, europium, uranium, and americium on Hainesville salt dome materials were made under aerobic and anoxic (<0.2 ppM oxygen) conditions using two synthetic groundwaters: one represented the Wilcox aquifer in the Hainesville region and the second was a dilute brine. Studies of the sorption of strontium, cesium, barium, cerium, europium, and uranium(VI) on granite and argillite were made under anoxic (<0.2 ppM oxygen) conditions and the results were compared to earlier measurements made under aerobic conditions. The sorption of uranium(VI) on argillite under atmospheric conditions was investigated. Measurements of migration rates in crushed granite, argillite, and tuff were made and compared with batch results. Infiltration experiments involving the forced injection of activity into intact and fractured cores were also performed. Microautoradiographic techniques were used to detect specific sorption sites. This latter technique was also used to characterize the sorption of plutonium and neptunium on polished thin-sections of alluvium, granite, tuff, and argillite and to assess the amount of aggregation that occurred. Additional physical and chemical characterizations of the materials used in these studies were made, and new analytical techniques were developed.

17437 (NUREG/CR—0912(Vol.2)) **Geoscience data base handbook for modeling a nuclear waste repository.** Isherwood, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1980. Contract W-7405-ENG-48. 331p. (UCRL—52719(Vol.2)). NTIS.

The three chapters of Volume 2 are the results of a scoping study on the geology, geomechanics, and hydrology of basalt and granite, and on the geology and hydrology of shale. The chapters include relatively complete compilations of the data currently available, as well as discussions of the properties that are unique to each rock type. Most of the data are, however, undigested; many of the figures and tables were taken from the original sources without extensive review. The use of symbols, especially in the sections on geomechanics, has been made generally consistent with the chapters of Volume 1; nonetheless, owing to the inconsistencies that pervade the literature, some differences remain. The discussion of shales in the present volume presents brief geologic descriptions of shale formations in the US and compiles extensive hydrologic data. The most thorough data are from the Great Basin, the Rocky Mountains, and the Colorado Plateau. The data on basalts are less copious. Nonetheless, geomechanical data are presented from a variety of places, notably Amchitka Island, the Great Lakes region (the Dresser Basalt), and the Columbia Plateau. The most useful hydrologic data have been collected at the Idaho National Engineering Laboratory and the Hanford Reservation on the Columbia Plateau. The geological descriptions of basalt flows focus on the Pacific Northwest. Data on granites come from widely scattered sources, including dam sites, tunnel sites, and quarries around the world.The most systematic geomechanical data, including the results of thermal modeling experiments, have been collected at the Stripa mine project currently underway in Sweden. The chapter on granites also includes descriptions of the major granite batholiths of the US and a discussion of fracture flow that is equally applicable to other rock types.

17438 (ORNL/TM—7125) **Waste sludge resuspension and transfer: development program.** Weeren, H.O.· Mackey, T.S. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-EN-26. 95p. Dep. NTIS, PC A05/MF A01.

The six Gunite waste tanks at Oak Ridge National Laboratory (ORNL) contain about 400,000 gal of sludge that has precipitated from solution and settled during the 35 years these tanks have been in service. Eventual decommissioning of the tanks has been proposed. The first part of this program is to resuspend the accumulated sludge, to transfer it to new storage tanks in Melton Valley, and to dispose of it by the shale-fracturing process. On the basis of

preliminary information, a tentative operational concept was adopted. The sludge in each tank would be resuspended by hydraulic sluicing and pumped from the tank. This resuspended sludge would be treated as necessary to keep the particles in suspension and would be pumped to the new waste-storage tanks. Subsequently the sludge would be pumped from the tanks, combined with a cement-base mix, and disposed of by the shale-fracturing facility. Verification of the feasibility of this concept required development effort on characterization of the sludge and development of techniques for resuspending the sludge and for keeping it in suspension. These development efforts are described in this report. Sections of the report describe both the known properties of the sludge and the tests of grinding methods investigated, discuss tests of various suspenders, describe tests with cement-base mixes, summarize hot-cell tests on actual sludge samples, and describe tests that were made at a mockup of a Gunite tank installation. On the basis of the tests made, it was concluded that reslurrying and resuspension of the sludge is quite feasible and that the suspensions can be made compatible with cement mixes.

17439 (PNL—2557) **Characterization of the Hanford 300 area burial grounds. Final report: decontamination and decommissioning.** Phillips, S.J.; Ames, L.L.; Fitzner, R.E.; Gee, G.W.; Sandness, G.A.; Simmons, C.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 255p. Dep. NTIS, PC A12/MF A01.

Pacific Northwest Laboratory conducted a series of investigations at the Hanford Site to develop technologies for characterizing and monitoring radioactive waste burial facilities that could be used in determining appropriate decommissioning alternatives. Specific objectives were to develop unique functional geophysics, geochemical, soil physics, numerical modeling, and biological methodologies needed to better characterize and monitor buried radioactive waste disposal sites. To meet these objectives the project was divided into four tasks: Task I, Geophysical Evaluation - Geophysical surveys were taken to locate and define the gross composition of waste materials. Task II, Geochemical Analysis - The interaction of disposed radionuclides with geologic media was analyzed through an integrated radiochemical procedure. Task III, Fluid Transport and Modeling - Computer modeling of water migration in partially saturated groundwater systems was verified with actual data collected at a field test facility used to monitor micrometeorological and geohydrological energy and mass transfer factors. Task IV, Biological Transport - Several biological organisms were evaluated for potential radionuclide uptake and transport. Along with the four tasks, the project included a review of pertinent literature and regulatory issues that might affect the alternatives selected. Surveys were taken of the surrounding area and specific sites and operations. The overall results indicated that the 300 Area Burial Grounds have been adequate in containing radioactive waste. Based on the results of the project, the alternatives identified for decommissioning these sites are exhumation and translocation, entombment, perpetual care, and abandonment. Perpetual care (currently used) appears to be the best decommissioning alternative for these burial grounds at this time. However, another alternative may be selected depending on future waste management policies, plans, or activities.

17440 (PNL—2782) **Assessment of effectiveness of geologic isolation systems. Test case release consequence analysis for a spent fuel repository in bedded salt.** Raymond, J.R.; Bond, F.W.; Cole, C.R.; Nelson, R.W.; Reisenauer, A.E.; Washburn, J.F.; Norman, N.A.; Mote, P.A.; Segol, G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 82p. Dep. NTIS, PC A05/MF A01.

Geologic and geohydrologic data for the Paradox Basin have been used to simulate movement of ground water and radioacrtive contaminants from a hypothetical nuclear reactor spent fuel repository after an assumed accidental release. The pathlines, travel times and velocity of the ground water from the repository to the discharge locale (river) were determined after the disruptive event by use of a two-dimensional finite difference hydrologic model. The concentration of radioactive contaminants in the ground water was calculated along a series of flow tubes by use of a one-dimensional mass transport model which takes into account convection, dispersion, contaminant/media interactions and radioactive decay. For the hypothetical site location and specific parameters used in this demonstration, it is found that Iodine-129 (I-129) is tthe only isotope reaching the Colorado River in significant concentration. This concentration occurs about 8.0 x 10^5 years after the repository has been breached. This I-129 ground-water concentration is about 0.3 of the drinking water standard for uncontrolled use. The groundwater concentration would then be diluted by the Colorado River. None of the actinide elements reach more than half the distance from the repository to the Colorado River in the two-million year model run time. This exercise demonstrates that the WISAP model system is applicable for analysis of contaminant transport. The results presented in this report, however, are valid only for one particular set of parameters. A complete sensitivity analysis must be performed to evaluate the range of effects from the release of contaminants from a breached repository.

17441 (RHO-BWI-C—29) **Drilling history core hole DC-8.** (Fenix and Scisson, Inc., Richland, WA (USA)). Oct 1978. Contract EY-77-C-06-1030. 51p. Dep. NTIS, PC A04/MF A01.

Core hole DC-8 was completed in August, 1978 by Boyles Brothers Drilling Company, Spokane, Washington, under subcontract to Fenix and Scission, Inc. The hole was cored for the US Department of Energy and the Rockwell Hanford Operations' Basalt Waste Isolation Program. Fenix and Scisson, Inc. furnished the engineering, daily supervision of the core drilling activities, and geologic core logging for hole DC-8. Core hole DC-8 is located on the Hanford Site near the Wye Barricade and 50 feet northwest of rotary hole DC-7. The Hanford Site vation coordinates for DC-8 are North 14,955.94 feet and West 14,861.92 coordinates for DC-8 are North 14,955.94 feet and West 14,861.92 mean sea level. The purpose of core hole DC-8 was to core drill vertically through the basalt and interbed units for stratigraphic depth determination and core collection, and to provide a borehole for hydrologic testing and cross-hole seismic shear and pressure wave velocity studies with rotary hole DC-7. The total depth of core hole DC-8 was 4100.5 feet. Core recovery exceeded 97 percent of the total footage cored.

17442 (RHO-BWI-C—40) **Drilling history core hole DC-4.** (Fenix and Scisson, Inc., Richland, WA (USA)). Dec 1978. Contract EY-77-C-06-1030. 48p. Dep. NTIS, PC A03/MF A01.

Core hole DC-4 was completed at a depth of 3998 feet in December, 1978 by Boyles Brothers Drilling Company, Spokane, Washington, under subcontract to Fenix and Scission, Inc. The hole was cored for the US Department of Energy and the Rockwell Hanford Operations' Basalt Waste Isolation Program. Fenix and Sicsson, Inc. furnished the engineering, daily supervision of the cable tool and core drilling activities, and geological core logging for DC-4. Core hole DC-4 is located on the Hanford Site about 3 miles east of the Yakima Barricade and approximately 103 feet southwest of rotary hole DC-5, which was completed to 3990 feet in February, 1978. Hanford Site coordinates reported for hole DC-4 are north 49,385.62 feet and west 85,207.63 feet, and Washington State coordinates are north 454,468.73 feet and east 2,209,990.87 feet. No elevation survey is available for hole DC-4, but it is approximately 745 feet above mean sea level based upon the survey of hole DC-5, which has a reported elevation of 745.16 feet on the top of the 3-inch flange. The purpose of core hole DC-4 was to core drill vertically through the basalt and interbed units for stratigraphic depth determination and core collection, and to provide a borehole for hydrologic testing, cross-hole seismic shear, and pressure wave velocity studies with rotary hole DC-5. Hole DC-4 was drilled through the overburden into basalt bedrock by cable tool methods (0-623 feet) and continuously cored through the final interval (623 to 3998 feet).Core recovery was 95.8 percent of the total footage cored.

17443 (RHO-LD—72) **Stratigraphy of the late Cenozoic sediments beneath the 216-B and C crib facilities.** Fecht, K.R.; Last, G.V.; Marratt, M.C. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Feb 1979. Contract EY-77-C-06-1030. 206p. Dep. NTIS, PC A10/MF A01.

The stratigraphy of the late Cenozoic sediments beneath the 216-B and C Crib Facilities is presented as lithofacies cross sections and is based on textural variations of the sedimentary sequence lying above the basalt bedrock. The primary source of data in this study is geologic information obtained from well drilling operations and geophysical logging. Stratigraphic interpretations are based primarily on textural analysis and visual examination of sediment samples and supplemented by drillers logs and geophysical logs.

17444 (RHO-LD—82) **Soil (sediment) properties of twelve Hanford wells with geologic interpretation.** Routson, R.C.; Fecht, K.R. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1979. Contract EY-77-C-06-1030. 58p. Dep. NTIS, PC A04/MF A01.

Laboratory soil (sediment) properties were determined for twelve study wells from an area south of the Hanford 200 West Area. Properties measured included: (1) mechanical analysis; (2) porosity; (3) $CaCO_3$ content; (4) moisture content at 0.33, 1.5, and 15 bars water potential; (5) field moisture content; (6) cation exchange capacity; and (7) bulk density. Geologic, stratigraphic cross sections were prepared using the above data and previously published data for the study area.

17445 (SAND—79-2015) **Preliminary inventory of pre-Cenozoic clay shales and argillites of the conterminous United States.** Connolly, J.R.; Woodward, L.A. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 51p. Dep. NTIS, PC A04/MF A01.

Cretaceous shales of the Western Interior of the United States occur in vast quantities and in thickness greater than 150 m (500 ft). Some older Mesozoic, Paleozoic, and Precambrian shale and argillites also appear to approach these thicknesses in deposits of consid-

erable lateral extent. These older rocks commonly have a lower proportion of expandable clays and lower water contents.

17446 (UCRL—15204) **Rock salt constitutive modeling.** Nickell, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Mar 1980. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

The Serata model is the best operational model available today because it incorporates: (1) a yield function to demarcate between viscoelastic and viscoplastic behavior of rock salt; (2) a pressure and temperature dependence for yield stresses; and (3) a standard linear solid, which can be readily extended into the nonlinear regime, to represent creep behavior. Its only deficiencies appear to be the lack of secondary creep behavior (a free dashpot) and some unsettling arbitrariness about the Poisson's ratio ($\nu \rightarrow 0.5$) argument for viscoplasticity. The Sandia/WIPP model will have good primary and secondary creep capability, but lacks the viscoplastic behavior. In some cases, estimated inelastic strains may be underpredicted. If a creep acceleration mechanism associated with brine inclusions is observed, this model may require extensive revision. Most of the other models available (SAI, RE-SPEC, etc.) are only useful for short-term calculations, because they employ temporal power law (t/sup n/) primary creep representations. These models are unsatisfactory because they cannot represent dual mechanisms with differing characteristic times. An approach based upon combined creep and plasticity is recommended in order to remove the remaining deficiency in the Serata model. DOE/Sandia/WIPP should be encouraged to move aggressively in this regard.

17447 (UCRL—15208) **Sources of data for biodose simulations used in bedded salt repository analysis.** Duffy, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jan 1980. Contract W-7405-ENG-48. 65p. Dep. NTIS, PC A04/MF A01.

Sources of parameter data for BIODOSE simulations are documented. These simulations were used in bedded salt repository analysis. Water system parameters are presented for a southwestern river system (patterned after the lower Colorado River). Nuclide-specific parameters are given also.

17448 (UCRL—52736) **MACRO1: a code to test a methodology for analyzing nuclear-waste management systems.** Edwards, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Dec 1979. Contract W-7405-ENG-48. 56p. Dep. NTIS, PC A04/MF A01.

The code is primarily a manager of probabilistic data and deterministic mathematical models. The user determines the desired aggregation of the available models into a composite model of a physical system. MACRO1 then propagates the finite probability distributions of the inputs to the model to finite probability distributions over the outputs. MACRO1 has been applied to a sample analysis of a nuclear-waste repository, and its results compared satisfactorily with previously obtained Monte Carlo statistics.

17449 (UCRL—82228(Rev.1)) **Modeling of brine migration in halite.** Cheung, H.; Fuller, M.E.; Gaffney, E.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1979. Contract W-7405-ENG-48. 10p. (CONF-791112—53). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

When canisters containing radwastes are emplaced in a repository the heat produced by the decaying radwaste will cause moderate thermal gradients to develop which will cause the brine present in a halite medium (salt deposits) to accumulate around the canister. Four different models of the migration process have been reviewed to determine their suitability as a working model. One model predicts that inclusions smaller than 0.1 mm dimension probably will not migrate. The other models do not consider size as a factor. Thermal diffusion (Soret effect) is considered insignificant in three models, while in the fourth model it is added to the concentration diffusion term. The following conclusions can be made: Temperature is the most significant parameter in all models and must be known as a function of time, and distance from the canister. All four models predict about the same migration velocity for it is a given set of conditions; for 100°C and 1°C/cm thermal gradient, it is 3.0, 4.8, 5.6 and 6.4 mm/y. Diffusion of ions through the brine inclusions is the rate controlling mechanism. The difference between the thermal gradients in the liquid and in the solid should always be considered and is a function of droplet shape. The model based upon work by Nernst is easiest to use, but it predicts the lowest migration rate. The maximum volume of pure brine accumulated at the canister surface would be less than 20-40 liters in 50 years, for a canister initial thermal power of 3.5 kW.Bitterns would migrate proportionately less volume. A computer code, BRINE, was developed to make these calculations by means of any of the four models.

17450 **Ocean dumping of high-level waste: an acceptable solution we can "guarantee".** Cohen, B. (Argonne National Lab., IL). *Nucl. Technol.;* **47**: No. 1, 163-172(Jan 1980).

What is needed for high-level radioactive waste is not necessarily a program for final disposal, but rather an early clear demonstration that an acceptable method is available. This would be especially easy for ocean dumping, since the environment in the water just above the ocean floor is much more uniform, stable, predictable, and more easily reproduced in a laboratory than other environments being considered for waste storage. Other probable advantages of ocean dumping are improved capability for monitoring and retrievability and reduced cost and transport problems. It is assumed that the waste is incorporated into glass and dumped in oceans distributed throughout the world. Calculations of environmental impacts are given for various assuptions about leach rates and failures and for a 30,000-yr delay in onset of leaching achieved by surrounding the waste with a protective coating. With normal leaching, there would be 0.17 eventual human fatalities per GW(electric)-yr, and for the worst case of immediate complete dissolution, this is increased by only 30%. This is 150 times less than the fatalities due to wastes from coal-fired plants.

17451 **Laboratory simulation of high-level liquid waste evaporation and storage.** Anderson, P.A. (Exxon Nuclear Idaho Co., Idaho Falls). *Nucl. Technol.;* **47**: No. 1, 173-180(Jan 1980).

Simulated high-level liquid waste (HLLW) slurries were prepared by combining a series of soluble stock solutions composed of commonly available chemical reagents. The properties simulated included acidity, nitrate concentration, quantities and composition of undissolved solids, density, and vicosity of HLLW at various degrees of evaporation. Limits of concentration by evaporation and stability during storage were studied. Steeling rates and particle sizes of the undissolved solids were estimated for stored HLLW. While considerable effort was expended to closely simulate actual reprocessing wastes, these data should be confirmed under actual process conditions.

17452 **Radioactive waste.** Blaylock, B.G. (Oak Ridge National Lab., TN). *J. Water Pollut. Control Fed.;* 1286-1291(Jun 1978).

42 papers dealing with high-level and long-lived radioactive wastes are reviewed. Many of these are general review papers covering a large body of literature. Different methods of waste disposal, i.e., disposal in geologic formations, ice sheet disposal, ocean disposal, and land burial and storage, are assessed as to their effects on human health through water pollution by the leached radioactivity. (BLM)

17453 **Durability of containers for storing solidified radioactive wastes.** Angerman, C.L.; Rankin, W.N. (Savannah River Lab., Aiken, SC). Contract AT(07-2)-1. *Mater. Performance;* **17**: No. 4, 9-18(Apr 1978).

Details are given of an analysis designed to identify materials suitable for storage of radioactive wastes incorporated into concrete or glass in above ground ambient air. Materials evaluated were carbon and low alloy steels, 304L steel, and Inconels 600 and 625. Wall thicknesses required for waste canisters were estimated from considerations of oxidation of the external surface, reaction with the waste-bearing concrete or glass, and strength to withstand the high internal pressures possible during thermal accidents. No material is expected to suffer excessive general, intergranular or pitting attack or any deterioration sufficient to disqualify it for the anticipated 100 year service life. The most desirable material from the standpoint of both properties and cost was 1020 carbon steel. For the glass waste form, can walls 1.27 cm (0.5 in.) would be required. For the concrete waste form, can walls 25.4 cm (10 in.) would be required if fire survival was chosen as a design-basis accident.

17454 **Investigation of gas formation on a low-level radioactive waste disposal site.** Eng, J.; Giardina, P.A. (Environmental Protection Agency, New York, NY). pp 519-524 of Energy and the environment. Proceedings of the fifth national conference. Nichois, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The results of work at low-level radioactive waste disposal sites will assist EPA in fulfilling its responsibility to establish requirements for protection of the environment and public health. Two workshops have already been held to discuss public policy. It is expected that low-level standards will follow in late 1981.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 17436, 18003

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 17447

17455 (UCRL—82236) **Repository post-sealing risk analysis using MACRO.** Kaufman, A.M.; Edwards, L.L.; O'Connell, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1980. Contract W-7405-ENG-48. 18p. (CONF-800313—4). Dep. NTIS, PC A02/MF A01.

From Waste management conference; Tucson, AZ, USA (10 Mar 1980).

MACRO, a code to propagate probability distributions through a set of linked models, is currently under development at Lawrence Livermore Laboratory. An early version of this code, MACRO1, has been used to assess post-sealing dose to man for simple repository and site models based on actual site data.

17456 **An Analysis of the mortality of workers in a nuclear facility.** Gilbert, E.S.; Marks, S. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Radiat. Res.;* **19**: No. 1, 122-148(Jul 1979).

Data from the Hanford plant, where many workers have been employed in jobs involving some exposure to radiation, are analyzed. Mortality from all causes, all cancers, and specific cancer types is related to personnel and exposure data for the population at risk. Results are compared with those of other investigators who have analyzed these data. The mortality of Hanford workers is first compared with that of the United States population and then related to radiation exposure without reference to an outside population. The first analysis shows a substantial "health worker effect" and no significantly high standardized mortality ratios for specific disease categories. A test for association of mortality with levels of radiation exposure reveals no correlation for all causes and all cancer. A statistically significant test for trend is obtained for multiple myeloma and cancer of the pancreas but no evidence of a positive correlation is found for 13 other cancer sites including those more typically associated with radiation exposure such as myeloid leukemia and lung cancer. The possibility of other occupational exposures and the lack of reliability with respect to diagnosis of cancer of the pancreas must be considered in terpreting these results. The identified correlations result from a small number of deaths with exposures greater than 15 rem. The lack of correlation for all cancrs and for leukemia is by no means inconsistent with current estimates of such effects given the amount of radiation exposure that has been received.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

17457 (MLM—2699(OP)) **Use of measurement verification by inspectors.** Strohm, W.W.; Inlow, R.O. (Monsanto Research Corp., Miamisburg, OH (USA). Mound Facility; Department of Energy, Albuquerque, NM (USA). Albuquerque Operations Office). 1980. Contract EY-76-C-04-0053. 2p. (CONF-800315—2). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Inspectors normally use measurements for material verification and for measurement verification. The results of measurement verification by US DOE inspectors are discussed. Biases in plutonium NDA measurements have been determined using calorimetric assay for a verification measurement. Application of the resulting bias corrections have significantly reduced inventory differences in DOE facilities.

17458 (UCRL—82222) **Structured Assessment Approach: a procedure for the assessment of fuel cycle safeguard systems.** Parziale, A.A.; Patenaude, C.J.; Renard, P.A.; Sacks, I.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Mar 1980. Contract W-7405-ENG-48. 5p. (CONF-800315—3). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

Lawrence Livermore National Laboratory has developed and tested for the United States Nuclear Regulatory Commission a procedure for the evaluation of Material Control and Accounting (MC and A) Systems at Nuclear Fuel Facilities. This procedure, called the Structured Assessment Approach, SAA, subjects the MC and A system at a facility to a series of increasingly sophisticated adversaries and strategies. A fully integrated version of the computer codes which assist the analyst in this assessment was made available in October, 1979. The concepts of the SAA and the results of the assessment of a hypothetical but typical facility are presented.

17459 (UCRL—82224) **Safeguards research at Lawrence Livermore Laboratory.** Dunn, D.R.; Huebel, J.G.; Poggio, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Mar 1980. Contract W-7405-ENG-48. 6p. (CONF-800315—4). Dep. NTIS, PC A02/MF A01.

From 2. symposium of the European Safeguards Research and Development Association; Edinburgh, UK (26 Mar 1980).

The LLL safeguards research program includes inspection methods, facility assessment methodologies, value-impact analysis, vulnerability analysis of accounting systems, compliance with regulations, process monitoring, etc. Each of those projects is described as are their goals and progress. (DLC)

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 17419

FUSION FUELS

17460 (CONF-791102—131) **Fusion reactor technology impact of alternate fusion fuels.** Baker, C.C.; Bolon, A.; Clemmer, R. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The initial results of a study carried out to assess some of the technology implications of non-D-T fusion fuel cycles are presented. The primary emphasis in this paper is on D-D, catalyzed-D and D-^{3}He fuel cycles. Tokamaks and field-reversed mirrors have been selected as sample confinement concepts. The technology areas considered include first wall design considerations, shielding requirements, fuel cycle requirements and some safety and environmental considerations. Conclusions resulting from the study are also presented.

PROCESSING

FABRICATION AND TESTING

17461 **Technological aspects of cryogenic laser-fusion targets.** Musinski, D.L.; Henderson, T.M.; Simms, R.J.; Pattinson, T.R.; Jacobs, R.B. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *J. Appl. Phys.;* **51**: No. 3, 1394-1402(Mar 1980).

Most current laser-fusion targets consist of hollow spherical glass shells which have been filled with a mixture of gaseous deuterium-tritium fuel. Theoretical considerations suggest that optimum yields can be obtained from these targets if the fuel is condensed as a uniform liquid or solid layer on the inner surface of the glass shell at the time it is irradiated. In principle, this can be accomplished in a straightforward way by cooling the target below the condensation or freezing point of the fuel. In practice, cryogenic targets can appear in routine laser experiments only when the necessary cryogenic technology is reliably integrated into experimental target chambers. Significant progress has been made recently in this field. The authors will discuss the scientific basis and the various technological features of a system which has allowed the successful irradiation of uniform solid-fuel-layer targets.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

ISOTOPIC POWER SUPPLIES

DESIGN AND FABRICATION

17462 (LA—8264-PR) **General-purpose heat source project and space nuclear safety and fuels program. Progress report.** Maraman, W.J. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

Studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Nuclear Systems and Projects Division of LASL are presented. The three programs involved are: general-purpose heat source development; space nuclear safety; and fuels program. Three impact tests were conducted to evaluate the effects of a high temperature reentry pulse and the use of CBCF on impact performance. Additionally, two $^{238}PuO_2$ pellets were encapsulated in Ir-0.3% W for impact testing. Results of the clad development test and vent testing are noted. Results of the environmental tests are summarized. Progress on the Stirling isotope power systems test and the status of the improved MHW tests are indicated. The examination of the impact failure of the iridium shell of MHFT-65 at a fuel pass-through continued. A test plan was written for vibration testing of the assembled light-weight radioisotopic heater unit. Progress on fuel processing is reported.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 17466

ELECTROLYSIS

REFER ALSO TO CITATION(S) 17532

17463 (EPRI-EM—1185) **Hydrogen production using solid-polymer-electrolyte technology for water electrolysis and hybrid sulfur cycle.** Sedlak, J.M.; Russell, J.H.; LaConti, A.B.; Gupta, D.K.; Austin, J.F.; Nugent, J.S. (General Electric Co., Wilmington, MA (USA)). Sep 1979. 130p. Dep. NTIS, PC A07/MF A01.

An evaluation was made of the comparative technoeconomics of hydrogen production using the General Electric Company's solid polymer electrolyte technology in two advanced processes: Water Electrolysis and Hybrid Sulfur Cycle Water Decomposition. In water electrolysis, based on the solid polymer electrolyte, only purified water is fed to the cell. The cell voltage is typically 1.65V at 1000 amp/ft^2 (ASF), 300 psia and 300°F. The sulfur cycle electrolyzer requires a feed stream of water and sulfur dioxide in concentrated sulfuric acid (50-80%). The cell reaction in this case is: $2H_2O + SO_2 \rightarrow H_2SO_4 + H_2$. Stoichiometrically formed sulfuric acid must be subsequently decomposed at very high temperature to recover the sulfur dioxide for recycling. An experimental solid polymer electrolyte sulfur cycle electrolyzer projected a voltage of 0.69 volts at 186 ASF in 50% H_2SO^4 at 300 psia and 183°F. Undesirable sulfur and sulfide by-products were detected at the cathode. Comparative costs of producing hydrogen by solid polymer electrolyte water electrolysis, and by solid polymer electrolyte sulfur cycle electrolysis, were determined on the basis of performance and economic analysis of plants running at a level of 380 million SCFD. The optimum solid polymer electrolyte water electrolysis plant operates with an overall efficiency of 40.2% at 1000 ASF and a hydrogen gate price of $2.25 per thousand SCF (at 1976 cost levels). A highly optimistic assessment of solid polymer electrolyte sulfur cycle plant indicated an overall efficiency of 42.5% at 400 ASF. The hydrogen gate price (at 1976 cost levels) was 9.8% higher than for solid polymer electrolyte water electrolysis. The principal conclusion of this study is that the solid polymer electrolyte-based hybrid sulfur cycle process shows no technological or economic advantage over existing (solid polymer electrolyte-based) water electrolysis systems for the production of hydrogen.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 17463

17464 **Method of generating hydrogen and oxygen from water .** Barnert, H.; Divisek, J.; Faul, W. (to Kernforschungsanlage Juelich Gesellschaft mit beschraenkter Haftung). US Patent 4,175,013. 20 Nov 1979. Priority date 24 Dec 1977, German, Federal Republic of (F.R. Germany), 8p.

A method is claimed of generating oxygen and hydrogen from water in which an acidic electrolyte containing formaldehyde is electrolyzed and produces oxygen and a gas which contains a low molecular-weight hydrocarbon. The low molecular-weight hydrocarbon is subjected to a catalytic conversion with water to produce synthesis gas consisting predominantly of hydrogen and carbon monoxide which are reacted to yield methanol. The methanol, in turn, is reacted to produce formaldehyde which is introduced into the electrolysis itself and hydrogen which is recovered. 9 claims.

STORAGE

REFER ALSO TO CITATION(S) 17908

CHEMISORPTION

REFER ALSO TO CITATION(S) 17851

17465 (SAND—79-7095) **Microstructure and hydriding studies of AB_5 hydrogen storage compounds. Final report.** Goodell, P.D.; Sandrock, G.D.; Huston, E.L. (International Nickel Co., Inc., Suffern, NY (USA). INCO Research and Development Center). Jan 1980. Contract EY-76-C-04-0789. 176p. Dep. NTIS, PC A09/MF A01.

New data on the microstructure, pressure-composition-temperature, and absorption/desorption kinetics of AB_5 metal hydrides are presented. The most significant result to emerge from the investigation is that many of the AB_5 metal hydrides, especially the $LaNi_5$ related materials, show instantaneous absorption and desorption response in proportion to the amount of cooling or heating which is provided. Eight categories of materials were studied: reference alloys ($LaNi_5$, $LaNi_{4.9}Al_{0.1}$, $LaNi_5Co_2$); Ni second phase particles ($LaNi_{5.67}$, $LaNi_7$, $LaNi_{11.3}$); eutectoid microstructure ($SmCo_5$); other second phases ($LaNi_{5.8}Fe_{1.2}$, $LaNi_{5.5}Cr_{1.5}$, $LaNi_4Cr$, $LaNi_4Si$; $LaNi_4Sn$, MNi_4Sn, $MNi_{4.3}Al_{0.7}$); substitutional elements ($LaNi_4Cu$, $LaNi_{4.5}Pd_{0.5}$, $LaNi_{4.7}Sn_{0.3}$, $LaNi_{4.8}Co_{0.2}$, $MNi_{4.3}Mn_{0.7}$); surface active elements ($LaNi_{4.8}B_{0.2}$, $LaNi_{4.9}S_{0.1}$, $LaNi_{4.9}Se_{0.1}$); large diameter atom substitutions ($Mg_{0.1}La_{0.9}Ni_5$, $Ca_{0.2}La_{0.8}Ni_5$, $Sr_{0.2}La_{0.8}Ni_5$, $Ba_{0.2}La_{0.8}Ni_5$); other compositions ($LaNi_3$); and Pd plating (electroless plated samples and mechanically alloyed specimens).

17466 **Hydrogen purification and storage system.** Billings, R.E. (to Billings Energy Corp.). US Patent 4,173,625. 6 Nov 1979. Filed date 21 Feb 1978. 8p.

A method of purifying and storing hydrogen or otherwise separating hydrogen gas from a gaseous mixture containing hydrogen is disclosed. A mixture of hydrogen and other gaseous components is applied under pressure to a hydride container holding a hydride forming material adapted to adsorb at least hydrogen from the gaseous mixture. Cooling of the hydride forming material facilitates adsorption of hydrogen and other gases from the gas mixture. By selectively heating the hydride forming material, following the adsorption step, hydrogen and the other adsorbed gases are selectively released and can, thus, be separated from each other. If hydrogen is the only gaseous component of the gas mixture which is adsorbed during the adsorption step, then substantially pure hydrogen is obtained by heating the hydrogen-loaded hydride material sufficiently to release the purified hydrogen therefrom.

UNDERGROUND

REFER ALSO TO CITATION(S) 18028

TRANSPORT

REFER ALSO TO CITATION(S) 17468

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 17463

INDUSTRIAL AND COMMERCIAL USE

17467 **Oxides of nitrogen and hydrogen peroxide levels from a hydrogen fueled combustion process.** Varde, K.S. (Univ. of Michigan, Dearborn). pp 568 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Growing concern over the atmospheric pollution and the possible depletion of our fossil fuel reserves have added incentives to efforts aimed at procuring alternate sources of energy for transportation systems. This has generated interests in hydrogen since it is considered to be nonpolluting and can be derived from water using a wide range of energy sources including nuclear and solar. However, it is expected that the combustion of hydrogen with air should lead to oxides of nitrogen in the burned gases. A recent experimental study also showed some evidence of hydrogen peroxide emission in the exhaust of a laboratory internal combustion engine. In the present work, we have tried to evaluate the potential of hydrogen from pollution considerations. A thermo-kinetic model is developed to predict emissions of H_2O_2 and oxides of nitrogen from a hydrogen fueled combustion engine. The model is based on 38 rate dependent forward and reverse chemial reactions involving 13 different species, namely, H_2, O_2, H_2O, OH, O, H, NO, N_2, N, NO_2, N_2O, H_2O_2 and HO_2. The model was applied to a four stroke, spark ignition engine running at 1500 rpm, with 15% lean and 10% rich fuel stoichiometry.

PROPERTIES

17468 (SAND—80-8202) **Hydrogen compatibility of structural materials for energy storage and transmission. Annual report, October 1, 1978-September 30, 1979.** Hoover, W.R.; Iannucci, J.J.; Robinson, S.L.; Spingarn, J.R.; Stoltz, R.E. (Sandia Labs., Livermore, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 70p. Dep. NTIS, PC A04/MF A01.

This annual report documents the activities and contributions accomplished during FY79 on a research contract aimed at assessing the feasibility of transporting hydrogen gas through the existing natural gas pipeline network. Studies of the hydrogen-induced degradation of pipeline steels reveal that hydrogen can be transported in these steels if a number of precautions are taken. These issues are discussed and plans for further research are presented.

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 17513

PROPERTIES

REFER ALSO TO CITATION(S) 17934

PREPARATION

CHEMICAL SYNTHESIS

17469 Conversion of synthesis gas to hydrocarbon mixtures utilizing dual reactors. Haag, W.O.; Huang, T.J. (to Mobil Oil Corp.). US Patent 4,159,995. 3 Jul 1979. Filed date 22 Aug 1977. 14p.

A gaseous mixture of carbon monoxide and hydrogen is contacted in a first reactor with an iron Fischer-Tropsch catalyst such as potassium promoted iron under special conditions and the total products from this contact are then converted in a second reactor containing an acidic crystalline zeolite, HZSM-5, to obtain either a highly olefinic or highly aromatic product depending on reaction conditions.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 17477, 17478, 17479

17470 (LBL—10090) **Hydrolyzed wood slurry flow modeling.** Wrathall, J.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

The project involves catalytic conversion of hydrolyzed wood slurry to fuel oil. Based on experience at the Albany PDU (operated by Rust Engineering), a process to convert Douglas Fir chips into a pumpable fuel at costs comparable to current spot prices for Middle Eastern crude oil was designed. Part of the task includes overcoming operating difficulties that have developed at the Albany pilot plant, one of which is production and handling of a pumpable, nonclogging hydrolyzed slurry as feedstock for a liquefaction process. A flow system has been set up to investigate the properties of the hydrolyzed slurry in hopes of acquiring proficiency in control of slurry flow and development of conditions and correlations that will be of general usefulness to the chemical engineering community. Operating directives will be issued based on the research which will be of value in solving some of the problems encountered at the Albany facility.

17471 Inverted vessel processing method for the production of methane gas. Chow, B.H. US Patent 4,157,958. 12 Jun 1979. Filed date 17 Mar 1978. 4p.

An apparatus for manufacture of combustible gas consisting principally of methane with minor amounts of carbon monoxide, carbon dioxide and hydrogen from organic wastes comprising an inverted vessel positioned in a body of water in a matter of such that the water acts as a liquid door to trap plant material and gas within the vessel. The combustible gas manufacturing method provided by the apparatus operates at a temperature of about 21°C to 37.8°C. Under ideal conditions it is possible to produce as much as about 11 ft^3 of gas/lb. of organic waste. A moving current of water agitates the organic material and sweeps the waste products from the bottom of the vessel where they may be recovered and used as fertilizer if desired.

PREPARATION

CHEMICAL SYNTHESIS

17472 Optical properties and electronic interactions of microcrystalline Cu/ZnO catalysts. Bulko, J.B.; Herman, R.G.; Klier, K.; Simmons, G.W. (Lehigh Univ., Bethlehem, PA). Contract AER-7503776; ET-78-S-01-3177. *J. Phys. Chem.;* **83**: No. 24, 3118-3122(29 Nov 1979).

Diffuse reflectance spectra of the microcrystalline Cu/ZnO solids provide evidence for interactions between an x-ray amorphous or solute form of copper and the ZnO wurtzite crystals. These interactions result in the emergence of a new absorption band at 17,500 cm^{-1} and the simultaneous spectral disappearance of the 25,800-cm^{-1} fundamental absorption edge of zinc oxide. This behavior is most pronounced when the copper concentration in the zinc oxide phase reaches the saturation value of 17 +- 1%. The copper solution in the zinc oxide is a highly degenerate semiconductor with a strong light absorption intensity in the visible region of the spectrum. A comparison with earlier observations of methanol synthesis activity of the Cu/ZnO catalysts shows that specimens containing a maximum amount of copper dissolved in the zinc oxide are also the best catalysts for methanol synthesis.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 17478, 17479

17473 (LBL—9220) **Process development studies on the bioconversion of cellulose and production of ethanol.** Wilke, C.R.; Blanch, H.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 39p. Dep. NTIS, PC A03/MF A01.

The biosynthesis of ethanol from cellulose is discussed. The following topics are covered: enzymatic hydrolysis of corn stover; high pressure hydrogen chloride process; cellulase production from Trichoderma viride by batch and continuous fermentation; studies on the composition of cellulase; enzyme recovery, media development, and growth factors in ethanol fermentation; xylose fermentation; and isolation of xylose fermentation; and isolation of xylose fermenting organisms. (DC)

17474 (LBL—9909) **Process development studies on the bioconversion of cellulose and production of ethanol.** Wilke, C.R.; Blanch, H.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 58p. Dep. NTIS, PC A04/MF A01.

The biosynthesis of ethanol from cellulose is discussed. The following topics are covered: enzymatic hydrolysis of bagasse; high pressure hydrogen chloride process; cellulase production by batch fermentation; studies on the composition of cellulase; enzyme recovery; media development and growth factors in ethanol fermentation; process development studies on ethanol production; xylase fermentation; and isolation of xylase fermenting organisms. Cost determinations for both enzymatic and acid hydrolysis are given. (DC)

17475 (LBL—10091) **Catalytic liquefaction of biomass.** Seth, M.; Djafar, R.; Yu, G.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 46p. (CONF-791166—1). Dep. NTIS, PC A03/MF A01.

From Thermochemical conversion contractors' meeting; Rolla, MO, USA (7 Nov 1979).

The subproject is divided into five tasks which cover exploratory research, investigation of process variables, investigation of process improvement options, product characterization, and product upgrading. In the first task, two new concepts for biomass liquefaction are being explored. The first involves solvolytic depolymerization of wood followed by hydrogenation of the resulting slurry (or solution). The second liquefaction concept being explored entails the hydrolysis of wood followed by hydrogenation of the hydrolyzed slurry. Acid-catalyzed transfer of hydrogen from solvent molecules is being tested for the hydrogenation step. In the second task, the effects of process variables on the yields and quality of products are being studied for three catalysts: sodium carbonate, ferric chloride and hydrogen iodide. The effects of reaction temperature, residence time, catalyst concentration, presence of reducing gases and type of feed (e.g., pre-hydrolyzed slurry vs wood flour) were determined for the ferric chloride system.

17476 (LBL—10219) **Rapid ethanol production via fermentation.** Maiorella, B.; Blanch, H.W.; Wilke, C.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 29p. (CONF-791108—19). Dep. NTIS, PC A03/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The flash-ferm process for industrial rapid ethanol fermentation with ethanol removal and concentration in an auxiliary flash vessel has been developed. The super high productivities (80 g ethanol/L.hr.) of the vacu-ferm processes are maintained while many disadvantages are eliminated. Flash-ferm combines synergistically with a vacuum distillation, providing a high ethanol concentration feed to the less strongly pinch limited separator. A 42% energy savings and a 54% reduction in manufacturing cost (exclusive of feed) is achieved as compared to conventional bath processes.

17477 Anaerobic fermentation: a solution to energy & environmental problems. Lizdas, D.J.; Coe, W.B. (United Technologies Corp., Windsor Locks, CT). pp 566 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Anaerobic fermentation of waste materials can produce 3 to 4 cu ft of methane per lb of volatile solids fed to the process. Biomass residue from the fermentation process has been found to have a crude protein content of ~ 25% and has potential as a cattle refeed ingredient.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 18057

17478 Wet oxidation of waste slurries with net energy recovery. Bishop, K.A.; Rosson, H.F.; Ramanathan, V. (Univ. of Kansas, Lawrence). pp 564 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This study was conducted to determine the feasibility of burning a manure slurry to supply boiler feedwater preheat for a small midwestern electric utility. The process was shown to be technically feasible and could produce energy at a cost of about $3.70 per million Btu at a 75% load factor. The major advantage of the process is that it extracts energy from undried manure. The major disadvantage is that the high chloride content requires expensive materials of construction resulting in high capital cost. This paper deals with the steady-state thermodynamic analysis.

GASEOUS WASTE FUELS

17479 Organic material from a coke quench tower. Sommerer, D.; Laube, A.H. (York Research Corp., Stamford, CT). pp 501-506 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses organic emissions from a coke quench tower. York Research Corporation (YRC) evaluated the quenching process at US Steel Company's Lorain Works. Water quality does not seem to be the major cause of organic emissions from these towers, but the exact causes are as yet unknow.

HYDRO ENERGY

RESOURCES AND AVAILABILITY

17480 (DOE/RA/01691—2) **Resource survey of low-head hydroelectric potential at existing dams and proposed sites in the Pacific Northwest Region: Phase II.** Gladwell, J.S.; Heitz, L.F.; Warnick, C.C. (Idaho Univ., Moscow (USA). Water Resources Research Inst.). Sep 1979. Contract EG-77-S-07-1691. 872p. Dep. NTIS, PC A99/MF A01.

This study evaluates the theoretical potential for small hydroelectric development of the Pacific Northwest Region. The study area includes all of the Columbia River system in the US and all other river basins in Idaho, Oregon, and Washington. The total area studied is approximately 292,000 square miles. The first phase (10 volumes) of the study completed in March 1979 evaluated the theoretical power potential of the streams in the region. This report is the completion report for Phase II of the study where an evaluation of the hydro potential is made for existing dams without present generating capabilities, proposed hydro sites, and at proposed power sites in existing irrigation systems. For this phase of the study, small hydro is defined as a site with potential to produce power between 200 kW and 25 MW with flows at the 50% exceedance level. The definition in Phase I called for power at the 50% exceedance to be greater than 200 kW and heads to be between 3 and 20 meters. DOE requested the definition change. Another aspect of this study involves evaluating transmission and load restraints at existing dams that do not have generating capabilities. Such items as distance to nearest power lines, capacity of that line, type of local market, and distance to nearest population center were evaluated - items that are important when making feasibility studies of hydro sites. (MCW)

LAND USE AND AESTHETICS

REFER ALSO TO CITATION(S) 18086

SOLAR ENERGY

17481 (SERI/TP—453-539) **SERI on-line models.** Birkenheuer, N. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 6p. (CONF-800101—16). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The Solar Energy Research Institute (SERI) Computer Center, is available to outside users via a value-added network. To provide additional support to the user community, a system for on-line access to computer models relating to solar applications is being developed. This project is designed to enhance and compliment the capabilities of the Solar Energy Information Data Bank (SEIDB) at SERI. The target user community for the On-Line Library includes Regional Solar Energy Centers (RESC's) affiliated institutions, DOE offices and laboratories, subcontractors, universities, and internal SERI users. Models selected for the library must be complete, operational and well documented. A broad range of applications will be available, including materials research, systems analysis, passive systems, market analysis, sizing, costing, and graphics. After a formal request is approved, the user will receive access to the system through an interactive executor program. This program allows model selection and execution, and processes accounting information. The capability to produce listings and, eventually, graphics at the central site to be mailed to remote users will also be provided.

RESOURCES AND AVAILABILITY

17482 (CONF-790845—, pp 195-197) **Use of standard surface weather observations to evaluate solar insolation in the Pacific Northwest.** Berkowitz, C.M.; Laulainen, N.S. (Battelle-Northwest, Richland, WA). 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

The solar radiation model of M.A. Atwater is used in conjunction with the National Climatic Center's TDF-1440 tapes of surface weather observations to estimate insolation in the Pacific Northwest. Meteorological considerations tentatively suggest that the Tri-Cities area in eastern Washington is the most suitable site for the utilization of solar energy.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

17483 (DOE/EV—0059) **Community impediments to implementation of solar energy.** Armstrong, M.D.; Armstrong, J.E. (SRI International, Menlo Park, CA (USA)). Nov 1979. Contract W-7405-ENG-48. 112p. Dep. NTIS, PC A06/MF A01.

The complete array of institutional problems expected to energy when solar technology are implemented on a national scale is assembled. The findings of the study are presented in two formats. First, the results are organized by the time frames of delays in solar implementation caused by the inherent difficulties a national energy policy would encounter in changing the way a given institution responds to specific solar technologies. Delay categories of 10 years or more, 6 to 8 years, and 3 to 5 years were selected; all were assigned under the assumption that a strong national policy promoting adoption of solar technologies would be in effect. The second format constitutes a description of the difficulties at the community level, associated with implementing each solar technology. (MHR)

17484 (DOE/EV—0067) **Land use and environmental impacts of decentralized solar energy use.** Twiss, R.H.; Smith, P.L.; Gatzke, A.E.; McCreary, S.T. (California Univ., Berkeley (USA)). Jan 1980. Contract W-7405-ENG-48. 206p. Dep. NTIS, PC A13/MF A01.

The physical, spatial and land-use impacts of decentralized solar technologies applied at the community level by the year 2000 are examined. The results of the study are intended to provide a basis for evaluating the way in which a shift toward reliance on decentralized energy technologies may eventually alter community form. Six land-use types representative of those found in most US cities are analyzed according to solar penetration levels identified in the

maximum solar scenario for the year 2000. The scenario is translated into shares of end use demand in the residential, commercial and industrial sectors. These proportions become the scenario goals to be met by the use of decentralized solar energy systems. The percentage of total energy demand is assumed to be 36.5 percent, 18.8 percent and 22.6 percent in the residential, commercial and industrial sectors respectively. The community level scenario stipulated that a certain percentage of the total demand be met by on-site solar collection, i.e. photovoltaic and thermal collectors, and by passive design. This on-site solar goal is 31.9 percent (residential), 16.8 percent (commercial) and 13.1 percent (industrial).

17485 Legal obstacles to decentralized solar energy technologies. Miller, A.S. *Sol. Law Rep.;* 1: No. 3, 595-612(Sep-Oct 1979).

The first of two sections of a survey of current issues in solar law focuses on the problem of ensuring solar access for decentralized applications. Providing for solar access is a complex problem, since solar access must be balanced against other desirable social goals. Existing law does not provide solar users with a right to sunlight, except in a few jurisdictions which have adopted one or another legislative scheme for protection of solar users. Public authorities may act to provide solar access protection, which will have the desirable effect of removing one uncertainty which may be a deterrent to potential purchasers of solar equipment. Such protection may be achieved on an areawide basis through zoning provisions, through requirements that the development process include consideration of the issue, or by other means. A number of jurisdictions have acted to provide a legal framework in which individuals may achieve protection of their access to sunlight on a lot-by-lot basis. Balancing the need of solar users for access to sunlight with the rights of adjacent property owners can be a complex task. The concept of transferable development rights offers at least one possible solution, although of limited application

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 17510, 17511

PHOTOVOLTAIC CONVERSION

17486 (CISE—1517) **High efficiency GaAs-GaAlAs solar cells for very high concentration systems.** Fanetti, E.; Flores, C.; Guarini, G. (Centro Sperimentale Metallurgico, Milan (Italy)). Oct 1979. 17p. (CONF-790954—2). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 18. international conference on solar energy; Milan, Italy (23 Sep 1979).

Basic data on design and processing of GaAs-GaAlAs solar cells for high concentration ratios are briefly reported. Conversion efficiencies up to 23% at 100 suns and 17% at 925 suns have been measured. The temperature variation of conversion efficiency was also checked up to 200°C and a close correlation between theoretical and experimental results was generally found.

17487 (CONF-800106—23) **Review of physics underlying recent improvements in silicon solar-cell performance.** Lindholm, F.A.; Fossum, J.G. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). 1980. Contract ET-78-C-01-3421. 4p. Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A unifying view of the physics of silicon solar cells is presented and used as a basis for explaining how recent improvements in the performance of these cells have been achieved. The unification is facilitated by a region-by-region analysis of the solar cell, which is also used to compare several recently proposed cell structures.

17488 (CONF-800106—24) **Influence of grain boundaries on recombination in polysilicon pn-junction solar cells.** Fossum, J.G.; Neugroschel, A.; Lindholm, F.A.; Mazer, J.A. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). 1980. Contract ET-78-C-01-3421. 7p. Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The physics controlling recombination in polysilicon pn-junction cells is described. Analytic models characterizing this recombination, whose parameters can be related directly to experiment, are developed. The analysis reveals that, in general, the description of intra-grain and grain-boundary recombination in a polysilicon solar cell requires the solution of a nonlinear, three-dimensional boundary-value problem. Cases of practical interest for which this problem is tractable are discussed. The analysis predicts an exp(qV/2kT) dependence (the reciprocal slope factor is exactly two) for carrier recombination at a grain boundary within the junction space-charge region of a non-illuminated, forward-biased cell. This result, and others of the analysis, are shown to be consistent with measured current-voltage characteristics of pn junctions fabricated on polycrystalline silicon.

17489 (DOE/ET/23006—2) **Solar Energy Laboratory second quarterly progress report, August 1, 1979-October 30, 1979.** Olsen, L.C. (Washington Univ., Richland (USA). Joint Center for Graduate Study). 1 Dec 1979. Contract AC04-79ET23006. 25p. Dep. NTIS, PC A02/MF A01.

Efforts this past quarter emphasized the assembly of a three source deposition system, studies of the chemical composition of the surface of Cu_2O substrates, continued investigation of current mechanisms in Cu/Cu_2O Schottky barriers, and fabrication and characterization of $Cu/SiO_2/Cu_2O$ MIS cells. Time was also devoted to further calculations of expected photocurrent from Cu_2O solar cells, and thermodynamic considerations concerning the stability of interfaces in possible Cu_2O cell structures. Key accomplishments include: (1) measurement of optical absorption coefficient for Cu_2O; (2) completion of MBE system; (3) preliminary identification of two current mechanisms operative in Cu/Cu_2O cells.

17490 (DOE/ET/23009—T1) **Thin film cadmium telluride solar cells. Technical progress report No. 1, July 1-September 30, 1979.** Chu, T.L. (Southern Methodist Univ., Dallas, TX (USA)). Oct 1979. Contract AC04-79ET23009. 33p. Dep. NTIS, PC A03/MF A01.

The objectives of this contract are to investigate thin films of cadmium telluride on low cost substrates and to demonstrate the feasibility of producing thin film cells with a conversion efficiency of 10% or higher. Efforts during the first quarter have been direcrted to the construction of apparatus for the chemical vapor deposition of cadmium telluride films, the selection and preparation of substrates, and the deposition and characterization of cadmium telluride films. Cadmium telluride films have been deposited on a number of substrates by the direct combination of cadmium and tellurium on the substrate surface at 550 to 740°C. At substrate temperatures below 550°C, the deposit is non-adherent. In the temperature range 580 to 740°C, the deposition rate is 0.5 to 1 μm/min, and the microstructure and crystallographic properties of deposited films have been investigated. Without intentional doping, cadmium telluride films deposited on mullite substrates have room temperature resistivities and carrier concentrations of (4-7) x 10^4 ohm-cm and (6-9) x 10^{12} cm^{-3}, respectively. Current-voltage measurements of Schottky barriers prepared from cadmium telluride films indicate the rectifying interface in CdTe/W/graphite, CdTe/graphite, CdTe/Al/graphite structures and the presence of pinholes in the films.

17491 (DOE/ET/23040—3) **Amorphous thin films for solar cell application. Quarterly report No. 3, October 1, 1979-December 31, 1979.** Jonath, A.D.; Monahan, K.M.; Crowley, J.L.; MacMillan, H.F. (Lockheed Palo Alto Research Labs., CA (USA)). 1979. Contract AC03-79ET23040. 17p. Dep. NTIS, PC A02/MF A01.

The identification, content, and role of impurities in a-Si thin films are sources of speculation not only for possible device performance degradation but also for their impact on film-property diagnosis. This concern is presently shared by those using all deposition processes, with oxygen and argon receiving attention as the most commonly introduced impurities. Oxygen to some degree (and with nitrogen) might have beneficial effects on film photoconductivity; yet device performance is said to suffer when oxygen concentration approaches one percent. Argon inclusion effects on film structure, resulting post-deposition oxidation, and the nature of the defect state are indicated but unclear. Emphasis this quarter was on (1) the measurement of oxygen concentration profiles through the film using Rutherford backscattering and nuclear reaction methods; and (2) the control over oxygen inclusion in the sputtered films. Progress is reported in detail.

17492 (DOE/ET/23044—T2) **Deposition, fabrication and analysis of polycrystalline silicon MIS solar cells. Quarterly technical progress report No. 3, July 1, 1979-September 30, 1979.** Anderson, W.A. (State Univ. of New York, Buffalo (USA). Dept. of Electrical Engineering). 30 Oct 1979. Contract AC03-79ET23044. 54p. Dep. NTIS, PC A04/MF A01.

A computer model has been established to predict MIS solar cell performance as a function of semiconductor and solar cell design parameters. The solar cell fabrication procedure was modified to more carefully examine the effect of t/sub ox/. An oxide growth temperature of 550 to 600°C was shown to give good values of FF, V/sub oc/, and J/sub sc/ which gave efficiency values consistently in the 9 to 10% range of Xtal-Si and 6.5 to 7.5% range on poly-Si. This revised process increased the average solar cell efficiency but did not increase maximum efficiency due to other parameters which were not optimum. I-V data for $77^0 K < T < 400^0 K$ were obtained for MIS solar cells on poly-Si. Unpolished poly-Si was shown to give space charge limited conduction indicative of a Gaussian trap distribution. Polished poly-Si gave a tunneling mechanism at low temperatures and tunneling via interface states at higher temperatures. Electron beam deposition of thin (20 μm) Si films on Al coated stainless steel was resumed during this quarter. These films showed good adhesion to the metal substrate. SEM studies revealed columnar growth with 5 μm dia columns. Radiation effect studies on MIS solar cells revealed an increased interface state density for proton and electron-irradianced solar cells. Auger studies on an

oxide-covered Si surface reveal a mixture of silicon oxide and oxygen atoms chemisorbed to the Si surface. (WHK)

17493 (DOE/ET/23046—1) **Electrodeposition of polycrystalline and amorphous silicon for photovoltaic applications. Quarterly technical progress report No. 01, June 11, 1979-September 10, 1979.** Rauh, R.D. (EIC Corp., Newton, MA (USA)). Nov 1979. Contract AC03-79ET23046. 20p. Dep. NTIS, PC A02/MF A01.

The first quarter of the contract period was spent principally in designing, constructing, and testing the two cells for low and high temperature electrodeposition of silicon. The glass, low temperature cell for use with organic solvents incorporates the advantageous features of a small cell volume requiring less than 50 ml of solvent, use of Ace threaded adapters for easy dismantling and cleaning, and an in-line geometry of the working electrodes and a window permitting illumination of the cathode during or after the electrodeposition. Several survey experiments were made with the glass cell using $SiHCl_3$ and $SiCl(CH_3)_3$ as the silicon precursors. Use of the former with AgCl/Ag as the reference electrode resulted in decomposition of the reference resulting in plating of silver on the electrode. It was also determined that $LiAsF_6$ is not usable as the supporting electrolyte with $SiHCl_3$. The cyclic voltammogram of the $SiCl(CH_3)_3$ solution showed two reduction peaks, but no indication of silicon deposition was observed. The high temperature cell for electrodeposition from molten salts was made from a nickel tube fitted with a lid using vacuum components to allow inlets for the electrodes, a pumping port, helium bubbler, and thermocouple. The salt mixture is contained in a molybdenum crucible. The salts were melted in the evacuated apparatus with the tube inserted into a resistance heated furnace, but to date no electrodeposition experiments have been performed.

17494 (DOE/JPL/1012—21) **Modeling of silane pyrolysis in a continuous flow reactor. Low-Cost Solar Array Project.** Praturi, A.; Jain, R.; Hsu, G.C. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Apr 1979. Contract EX-76-A-29-1012. 48p. Dep. NTIS, PC A03/MF A01.

Silane pyrolysis in a continuous flow pyrolyzer is a simple process that is currently being developed for producing solar cell grade silicon. The process involves complex phenomena, however, including thermal decomposition of silane, nucleation and growth of silicon particles, and mass and heat transfer. Modeling the effects of transport phenomena on silane pyrolysis in a continuous flow pyrolyzer is discussed. One- and two-dimensional models are developed to predict velocity, temperature, and concentration profiles in the reactor. The one-dimensional model has been implemented as a computer code.

17495 (DOE/JPL/954343—17) **Process feasibility study in support of silicon material task 1. Quarterly technical progress report (XVII), September-November 1979.** Li, K.Y.; Hansen, K.C.; Yaws, C.L. (Lamar Univ., Beaumont, TX (USA). Dept. of Chemical Engineering). Dec 1979. Contract NAS-7-100-954343. 31p. Dep. NTIS, PC A03/MF A01.

Analyses were continued for process system properties of chemical materials important in the production of silicon. Primary activities were initiated for physical, transport and thermodynamic property data of silicon. Progress and status including preliminary data collection and analysis results are reported for the primary activities of data collection (90%), data analysis (80%), estimation (70%), and correlation (60%). Process design results for BCL process-Case A (two deposition reactors and six electrolysis cells) were presented recently. During this reporting period, major chemical engineering efforts were initiated on preliminary process design of the BCL process-Case B (one deposition reactor and two electrolysis cells). Chemical engineering design results are reported for Case B including raw materials, utilities, major process equipment and production labor requirements for a silicon plant of 1000 MT/yr capacity. For economic analysis, major efforts centered on cost sensitivity analysis for the BCL process-Case A for producing silicon. Cost sensitivity results are presented for the influence of primary cost parameters. For both 1975 and 1980 time periods, the results indicate that the cost parameters influence on product cost is: plant investment (most), raw materials (intermediate), utilities (intermediate) and labor (least). For profitability, the results indicate a sales price of 14 $/kg (1980 dollars), at a 7.5% DCF rate of return on investiment after taxes. These results suggest good potential of the BCL process for meeting the LSA cost goal of $14 per kg (1980 dollars).

17496 (DOE/JPL/954521—3) **Integral glass encapsulation for solar arrays. Quarterly progress report No. 11.** Younger, P.R. (Spire Corp., Bedford, MA (USA)). Sep 1979. Contract NAS-7-100-954521. 13p. Dep. NTIS, PC A02/MF A01.

This is the eleventh quarterly report under JPL/DOE program for the development of electrostatic bonding as a method of integrally encapsulating silicon solar cells in glass. Efforts for the current phase of this program are to continue to demonstrate process uniformity of encapsulation by electrostatic bonding. An additional goal for this program is to develop preformed contacts as a method of integrating cell processing into the encapsulation procedure, resulting in a low-cost module assembly technique. This report covers work performed during the period from 11 July - 10 October 1979.

17497 (DOE/JPL/954847—79/5) **Phase 2 of the automated array assembly task of the low-cost silicon solar array project. Technical quarterly report No. 4, April 1-June 30, 1979.** Coleman, M.G.; Pryor, R.A.; Sparks, T.G. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-954847. 35p. Dep. NTIS, PC A03/MF A01.

During this period, all tasks progressed according to scheduled plans. This report highlights the process verification efforts, ion implantation investigations, plasma etching, and cost factors in the metallization processes. Completed modules were delivered to JPL to demonstrate the process sequence. A surface film has been observed on ion implanted wafers which was tentatively been associated with break-down of the vacuum pump oil during implantation. A baseline process for plasma patterning of silicon nitride on a silicon substrate has been specified. In addition, copper has been shown to have strong cost advantages over other metals for a conductor layer; and nickel has been identified as a desirable barrier between copper and silicon.

17498 (DOE/JPL/954882—15) **Process development for automated solar cell and module production. Task 4. Automated array assembly. Annual report.** Witham, C.R. (MB Associates, San Ramon, CA (USA); ARCO Solar, Inc., Chatsworth, CA (USA)). 12 Jun 1979. Contract NAS-7-100-954882. 127p. Dep. NTIS, PC A07/MF A01.

MBA has been working on the automated array assembly task of the Low-Cost Solar Array project. A baseline sequence for the manufacture of solar cell modules is specified. Starting with silicon wafers, the process goes through damage etching, texture etching, junction formation, plasma edge etch, aluminum back surface field formation, and screen printed metallization to produce finished solar cells which are then series connected on a ribbon and bonded into a finished glass, PVB, tedlar module. A number of steps required additional developmental effort to verify technical and economic feasibility. These steps include texture etching, plasma edge etch, aluminum back surface field formation, array layup and interconnect, and module edge sealing and framing.

17499 (DOE/JPL/954886—79/8) **LSA large area silicon sheet task continuous liquid feed Czochralski growth. Quarterly report, July-September 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Oct 1979. Contract NAS-7-100-954886. 21p. Dep. NTIS, PC A02/MF A01.

This project, currently in its second phase, is directed toward the design and development of equipment and processes to demonstrate continuous growth of crystals by the Czochralski method, suitable for producing single silicon crystals for use in solar cells. Continuous is defined as the growth of at least 150 kg of monosilicon crystal, 150 mm in diameter, from one growth container. The approach to meeting this goal is to develop a furnace with continuous liquid replenishment of the growth crucible, accomplished by a meltdown system with a continuous solid silicon fedd methanism and a liquid transfer system, with associated automatic feedback controls. In order to establish process parameters for conventional CZ growth of 150 mm ingots, several runs with 12-kg charges were performed, and solidification rates of 2.7 to 3.5 kg/hr were achieved. Significant progress has been made in the development of a new melt transfer system. Basic material problems relating to the high temperature environment were solved. The cost of the new transfer mechanism is lowered substantially through multiple use of the major system components. Manufacturing of parts and installation of the polyrod feed mechanism for continuous recharging of the meltdown chamber were completed together with the feedback control system which uses the melt level sensor belonging to the growth crucible as input. The design for a continuous particle feeder into the meltdown chamber has been completed, and the fabrication of this system is currently in progress. Several short melt replenishment runs with 5 to 8 kg of continuous melt transfer were performed in an effort to develop feedback control systems for solid rod and particle feeding as well as to establish the permissible pressure region in which melt transfer can be assured.

17500 (DOE/JPL/955164—79/3) **Development of economical improved thick film solar cell contact. Quarterly report No. 3, May-July 1979.** Ross, B. (Bernd Ross Associates, San Diego, CA (USA)). Aug 1979. Contract NAS-7-100-955164. 61p. Dep. NTIS, PC A04/MF A01.

The potential for economy and efficiency has been demonstrated for the thick film metallization process using screen printing for solar cell electrodes. However, process reliability and materials economy remain deficient. It is believed that these deficiencies can be removed by the use of ink formulations designed specifically for silicon solar cells, departing from ceramic technology tradition and utilizing all metal systems. Various measurement methods of series

resistance and specific contact resistance were considered. Several attempts were made to produce eutectic alloys in air and in neutral (nitrogen) atmospheres, but the resulting product was not considered satisfactory. A commercial source of eutectic aluminum-silicon and aluminum-germanium was located. Fifteen all metal pastes were fabricated during this reporting period including 12 base metal pastes. Silver inks fired in hydrogen were non-adherent. Electrical results of screened solar cell tests were poor, indicating diffused layer penetration. Similar results occurred with titanium-palladium-silver controls. A survey was made of alloys containing nickel and copper. Solubilities of nickel, silver and copper in various low melting metals were calculated from the phase diagrams and plotted. An ink milling procedure was written for all metal inks. Base metal powders were ordered and partially received. A tube furnace was purchased and installed, along with a gas handling system, designed for hydrogen and nitrogen firing.

17501 (DOE/JPL/955201—79/4) **Low cost solar array project composition measurements by analytical photon catalysis. Final report, October 1, 1978-September 30, 1979.** Sutton, D.G.; Galvan, L.; Melzer, J.; Heidner, R.F. III. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 1979. Contract NAS-7-100-955201. 44p. Dep. NTIS, PC A03/MF A01.

The object of this research is to assess the applicability of the photon catalysis technique for effecting composition analysis of silicon samples. In particular, the technique is to be evaluated as a detector for the impurities Al, Cr, Fe, Mn, Ti, V, Mo and Zr. During the first year Al, Cr, Fe, Mn, Ti and Si have been detected with the photon catalysis method. The best fluorescence lines to monitor were established, and initial sensitivites to each of these elements were established by atomic absorption calibration. In the course of these tests vapor pressure curves for these six pure substances have also been mapped. The detection of these impurities in silicon matrices were studied. The evaporation process was shown to be congruent; thus, spectral analysis of the vapor will yield the composition of the bulk sample. Qualitative analysis of metal impurities in silicon was demonstrated below the part per million level. A parametric study for the purpose of establishing optimal running conditions was completed. The parameters varied were temperature, nitrogen and argon pressures, pumping speed, and microwave power. In addition to these mainline tasks much ancillary information was obtained. The emission signatures were determined for several additional elements including As, Bi, B, Ca, Cu, Cr, Ga, Ge Mg, Na, P and Pb. Ionic emission lines for Ca and Mg were determined to be useful for analysis.Many metal hydrides and alkyls were found to be detectable by the active nitrogen technique. As a result of these studies it is concluded that the photon catalysis technique is suitable for bulk analysis of solar grade silicon. (WHK)

17502 (DOE/JPL/955265—1) **Automated array assembly task. Development of low-cost polysilicon solar cells. Quarterly technical report No. 1.** Allison, K.L.; Rhee, S.S.; Jones, G.T. (Sensor Technology, Inc., Chatsworth, CA (USA)). Jun 1979. Contract NAS-7-100-955265. 51p. Dep. NTIS, PC A04/MF A01.

Wacker material was the only polysilicon material considered during this reporting period, due to late delivery of other materials types. A batch of 10.1% efficient Wacker polysilicon solar cells were produced using the baseline fabrication sequence with standard $POCl_3$ gettering, spray-on-dopant junction formation and SiO AR coating. The highest efficiency obtained from this batch as 10.5%. The average crystal grain size for a sample lot of Wacker polysilicon wafers was found to be 0.16 inches. This result was employed to show that insufficient gridline coverage of polysilicon crystal grains can lead to a significant power loss. A theoretical and experimental comparison between single crystal and polysilicon solar cell efficiencies was used to investigate the impact of the structural properties of polysilicon material on solar cell efficiency. The experimental data obtained in this study are in agreement with the theoretical predictions of the diffusion length model of polysilicon material. On the basis of this correlation, it was concluded that the lower efficiencies of polysilicon solar cells made from Wacker polysilicon material, relative to single crystal silicon olar cells, are not due to processing inadequacies, but rather to grain boundary effects.

17503 (DOE/JPL/955325—2) **Vacuum die casting of silicon sheet for photovoltaic applications. Second quarterly report, 1 July-30 September 1979.** (ARCO Solar, Inc., Chatsworth, CA (USA)). 1979. Contract NAS-7-100-955325. 39p. Dep. NTIS, PC A03/MF A01.

The objective of this program is to develop a vacuum die-casting process for producing silicon sheet suitable for photovoltaic cells and to develop production techniques for optimization of polycrystalline silicon solar cell output. Efforts will examine process methods which are directed toward minimum cost processing of silicon into a quality suitable for producing solar cells with a terrestrial efficiency greater than 12% and having the potential to be scaled for large quantity production. In the vacuum die casting technique, silicon is melted under vacuum, and an evacuated die with a thin rectangular cavity is inserted into the melt. Liquid silicon is then injected into the die using a positive pressure of an inert gas. The vacuum die casting process requires a die which is not wetted by molten silicon and does not react with it. A variety of potential die materials were evaluated during this period and a number of casting attempted. A standard process has been demonstrated for polycrystalline solar cells using Wacker SILSO material in both aerospace and terrestrial manufacturing sequences. The cells show excellent curve fill factors with good efficiency but some current output reduction due to lowered long wavelength response. An experiment to evaluate phosphorous diffusion scattering for polycrystalline material is in progress. The use of screen printed aluminum to achieve a back surface field has resulted in enhanced red response but open circuit voltages have not exceeded 565 mV for material with a bulk resistivity ranging from 1 to 5 ohm-cm.

17504 (DOE/JPL/955415—1) **Effects of varying oxygen partial pressure on molten silicon: ceramic substrate interactions. Quarterly report No. 1.** Ownby, P.D.; Romero, H.V.; Barsoum, M.W. (Missouri Univ., Rolla (USA). Dept. of Ceramic Engineering). Oct 1979. Contract NAS-7-100-955415. 28p. Dep. NTIS, PC A02/MF A01.

Activity at UMR this quarter has been in three areas: (1) investigation of the devitrification of fused silica under various oxygen partial pressures; (2) construction of a thoriayttria solid solution electrolyte portable oxygen sensor; and (3) theoretical development and application of a method of calculating the surface free energy of ceramic substrates from silicon sessile drop contact angle and oxygen partial pressure measurements. Results are reported. (WHK)

17505 (DSE—4042-T28) **Development of polycrystal GaAs solar cells. Quarterly technical progress report No. 3, August 1, 1979-October 30, 1979.** Miller, D.L.; Cohen, M.J.; Harris, J.S. Jr.; Ballantyne, J.; Stefanakos, E. (Rockwell International Corp., Thousand Oaks, CA (USA). Electronics Research Center; Cornell Univ., Ithaca, NY (USA); North Carolina Agricultural and Technical State Univ., Greensboro (USA)). Dec 1979. Contract EG-77-C-01-4042. 49p. Dep. NTIS, PC A03/MF A01.

Progress at Rockwell International, Cornell University, and North Carolina A and T State University on the development of thin film polycrystal GaAs solar cells with a 10% conversion efficiency is described. Highlights include the growth of Ge on Fe substrates and the investigation of various grain boundary passivation schemes. (WHK)

17506 (SAN—3042-2) **Amorphous silicon solar cells by hydrogen implantation. Quarterly report No.2, 1 April-30 June 1979.** Kirkpatrick, A.R.; Melas, A.A. (Spire Corp., Bedford, MA (USA)). Aug 1979. Contract AC03-79ET23042. 19p. (QR—10064-02). Dep. NTIS, PC A02/MF A01.

The mass of a silicon film for an amorphous device cannot be deposited by ion implantation. It is likely, however, that implantation can be used to modify an existing nonamorphos silicon film to achieve the material characteristics and device structure required for an amorphous cell. This specific possibility is to be examined. Cell devices are to be fabricated of CVD polysilicon deposited upon isolated substrates. Implanatation is to be employed to amorphize and hydrogenate the active material of the already functional devices. Two ion implantation machines being used for investigation under this program can provide the ions of immediate interest, $^{1}H^{+}$, $^{11}B^{+}$, $^{16}O^{+}$, $^{19}F^{+}$, $^{28}Si^{+}$, $^{31}P^{+}$, $^{40}Ar^{+}$, at energies from 10 through 200 keV and at beam currents of a few hundred microamperes or more. Some of the ions, hydrogen in particular, may be utilized in very high level doses. The available implanters are adequate for study purposes. Much higher current machines would be needed for cost effective production processing. Such machines are already feasible by use of designs based upon existing technology. Investigations under this program are to emphasize the use of cell devices to provide information regarding application of ion implantation to amorphous silicon cells. Special ion implantation procedures and analyses are required. Developmental activities described include the preparation of implantation capabilities and procedures, preparation of processing routines for a test cell device and preliminary evaluation of the effects of hydrogen implantation upon operation of devices. (WHK)

17507 (SERI/TP—32-134) **Heterojunction solar cells.** Wagner, S. (Solar Energy Research Inst., Golden, CO (USA)). 1978. Contract EG-77-C-01-4042. 17p. (CONF-7811142—1). Dep. NTIS, PC A02/MF A01.

From Royal Society discussion meeting on solar energy; London, UK (15 Nov 1978).

A qualitative description of semiconductor/semiconductor heterojunction solar cells is given. The two groups of heterojunctions of greatest economic potential, very highly efficient cells for concentrator applications and moderately efficient thin film cells for flat plates, are described with examples. These examples illustrate the role of heterojunctions in surface passivation, monolithic multijunction devices, devices with semiconductors of only one conductivity type, and low-temperature fabrication techniques.

17508 Field-dependent quantum efficiency in hydrogenated amorphous silicon. Crandall, R. (RCA Laboratories, Princeton, New Jersey 08540). AC-03-78ET21074. *Appl. Phys. Lett.;* **36**: No. 7, 607-608(1 Apr 1980).

A model calculation of the electric field dependence of the quantum efficiency for electron-hole pair production in hydrogenated amorphous silicon is presented and compared with recent measurements of the electric field dependence of the solar-cell collection efficiency. The theory, based on electric field reduction of geminate recombination of the excited electron-hole pair, agrees well with experiment.

17509 Black a-Si solar selective absorber surfaces. Messier, R.; Krishnaswamy, S.V.; Gilbert, L.R.; Swab, P. (Materials Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania 16802). EM-78-C-04-5302;DE-ACO3-79ET23038. *J. Appl. Phys.;* **51**: No. 3, 1611-1614(Mar 1980).

Amorphous Si films display a unique anisotropic etching phenomenon in which a columnar microstructure results. The alignment of the anisotropic microstructure is related to the average angle of the depositing material. Since cross-sectional spacing of the columns is less than the wavelength of light, a continuous grading of the refractive index occurs and results in a drastic reduction in the total reflectance from 40 to 50% in the as-deposited film to <2% in the etched film. The etchant, HF/HNO_3, apparently oxidizes rapidly down aligned void networks followed by an equally rapid dissolution and removal step. Such a semiconductor film on a low ir emmisivity metallic substrate is a potentially efficient photothermal selective absorber surface.

17510 Electricity from sunlight: low cost silicon for solar cells. Yaws, C.L. (Lamar Univ., Beaumont, TX); Miller, J.W. Jr.; Lutwack, R.; Hsu, G. pp 329-334 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The conversion of sunlight into electricity in a solar cell comprises an attractive alternate energy source. However, the cost of the primary material (silicon) making up the solar cell is too expensive at the present time. Low cost silicon for solar cells is needed. Several manufacturers have proposed new processes that depart from conventional technology. These new processes, which are still in the initial stages of development, are discussed along with the conventional technology.

17511 Effects of weather and pollution on incident solar energy: basic measurements leading to computer models. Lerfald, G.M.; Derr, V.E. (Environmental Research Labs., Boulder, CO). pp 335-338 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A program of experimental measurements and analysis is being conducted to better define the roles played by the scattering and absorbing components in the atmosphere on the spectral transmission of solar radiation. These components include water vapor, stratospheric ozone, lithometeors, hydrometeors and the standard atmospheric gases. The measurements are being made in several climate regimes. Simultaneous observations by a large backscatter lidar, solar spectral photometers, infrared radiometers, acoustic sounder, in situ particle samplers, and time lapse sky cameras permit determination of each of the absorbing/scattering components, separately. Data sets have been collected at Boulder, Colorado, Fairplay, Colorado, Colstrip, Montana, and Pt. Mugu, California. Measurements are planned for sites in the northeast and southeast USA next year. The primary objective of the work is to provide uniquely complete data sets useful in the testing and development of computer models to predict and map solar radiation characteristics at ground level.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 17470, 17471, 17473, 17474, 17475, 17476, 18057

17512 (CONF-790845—, pp 275-278) **Biomass in the Northwest: available inventory.** Miles, T.R. 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

The PNW uses 2% (1.67 out of 78 Quads) of the nation's energy but has twice the proportionate available biomass, 33% as compared to 15% of total use. Aside from economics, geographic location and road accessibility are the principal problems for utilization, with conversion systems the least troublesome. Biomass and residue distributions and characteristics are shown and described. Various fuels are identified as to Btu value and cost per million Btu's ($M Btu), ranging from stationary sawmill residue at $.67/MBtu to portable methanol at $19.26/MBtu. Conversion systems and their relative energy efficiencies indicate that some fermentation systems actually compare very favorably - .38 to .48 EFF - with the direct combustion pathway to KW at .27 EFF. Portable energy to replace gasoline is a critical problem; stationary energy systems are more versatile.

17513 (ORO—5912-T2) **Production of sugarcane and tropical grasses as a renewable energy source. Second annual report, 1978-1979.** (Puerto Rico Univ., Rio Piedras. Agricultural Experiment Station). 1979. Contract ET-78-S-05-5912. 134p. Dep. NTIS, PC A07/MF A01.

Reseach continued on tropical grasses from Saccharum and related genera as sources of intensively-produced, solar-dried biomass. Categories of candidate grasses include short-, intermediate-, and long-rotation species. These categories are based on the time interval required for maximum dry matter production, and on future management requirements of energy crops for intensive co-production with food crop commodities. Year 1 studies at the greenhouse and field-plot levels were continued and broadened during Year 2. This included candidate screening, importation and quarantine of new clones, breeding, controlled nitrogen and water regimes, chemical growth control, tissue expansion and maturation control, seeding rates, harvest frequency, and variable row spacing. Second-year studies were extended to the project's field-scale and mechanized-harvest phases. These include initial economic anayses for the short-rotation phases. These include initial economic analyses for the short-rotation category of candidate species.

17514 Fuels from biomass: integration with food and materals systems. Lipinsky, E.S. (Battelle Columbus Labs., OH). *Science;* **199**: 644-651(10 Feb 1978).

The development of fuels from biomass can lead naturally to dispersed facilities that incorporate food or materials production (or both) with fuel production, forming adaptive systems that can be modified to meet evolving needs and constraints. The technology that is appropriate to each system needs to be worked out, taking into account associated food and materials opportunities in order to decrease the ultimate cost of energy delivered to the consumer. Possible systems based on sugarcane, corn, and guayule are analyzed.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 17923

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 17516, 17757, 17810

17515 (DOE/JPL/1012—36) **1982 technical readiness module design and test specification: intermediate load applications. LSA engineering area.** (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1980. Contract EX-76-A-29-1012. 34p. Dep. NTIS, PC A03/MF A01.

The requirements for the design and test of terrestical solar cell modules for one phase of DOE's Low-Cost Solar Array project are established. In addition to module design and performance requirements a series of characterization and qualification tests necessary to certify the module design are also specified. (MHR)

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 17582, 17683

17516 (DOE/ER—0041) **Satellite Power Systems (SPS): concept development and evaluation program, preliminary assessment.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Sep 1979. 21p. Dep. NTIS, PC A02/MF A01.

The Satellite Power System (SPS) is an emerging concept for capturing solar energy in space for use in producing electrical energy on earth. To develop an understanding of the technical and economic feasibility and of the environmental and societal acceptability of the SPS is an enormous challenge. The Department of Energy and the National Aeronautics and Space Administration are engaged in a three-year assessment of the SPS that began in the fall of 1977 and will be completed in the summer of 1980. The DOE/NASA assessment is engaging the efforts of many organizations in the United States and is developing a large body of information. At approximately the mid-point of the assessment, this preliminary

project assessment report describes what has been done and what has been learned with an emphasis on the overriding issues.

17517 (SERI/TP—313-492) **Advanced Solar Thermal Technology Program. Meeting abstracts.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1979. Contract EG-77-C-01-4042. 166p. (CONF-791221—). Dep. NTIS, PC A08/MF A01.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Separate abstracts were prepared for the 28 papers included. (WHK)

17518 (SERI/TP—313-492, pp 74-78) **Small solar electric system demonstration.** Poirier, A. (Sanders Associates, Inc., Nashua, NH). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Several components of a small solar power system module were analyzed to verify performance and to demonstrate that a checker stove concept represents a viable candidate for dispersed solar power system applications. The three-phase program to fulfill these objectives is in its third phase. During the first phase a design point analysis was performed on a checker stove. During the second phase, a preliminary system analysis was performed and prototype components were fabricated. Phase III encompasses fabrication of the checker stove and ancillary and test equipment, and equipment performance testing. These tests, to be completed by February 1980, will verify the design and provide the data needed for evaluation of the concept.

17519 (SERI/TP—313-492, pp 79-84) **Free-piston solar Stirling engine-alternator.** Dochat, G.R. (Mechanical Technology Inc., Latham, NY). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Over the past few years, MTI has concentrated on the development of free-piston Stirling engines. MTI is committed to product commercalization of free-piston Stirling engines in the power size ranges from 1 to 25 KW. The free-piston Stirling engine (FPSE) product development program is investigating a number of potential applications. Free-piston Stirling engines are attractive because of their high system efficiency and potential for long life, inherent reliability, and maintenance free characteristics. It is these characteristics which make the free-piston engine driving a linear alternator desirable for small, dispersed solar thermal electric power systems. The general conclusions of a recently completed study with NASA/Lewis for a conceptual design of a 15 KW free-piston solar Stirling engine are reviewed, and how the required technology identified in that study is presently being addressed with hardware testing is discussed.

17520 (SERI/TP—313-492, pp 87-92) **Quality assurance and standards for advanced solar thermal systems.** Cobb, H.R.W. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The goal initially established for FY 80 for Quality Assurance and Standards within the total solar thermal program is the development of a plan for establishing input to codes and standards development, performance and safety criteria and test methodologies and a coordinated quality assurance program. The advanced solar thermal technology program emphasizes development of subsystems, components and materials that are specific to its requirements. Therefore it follows that its contribution to standards development will most likely be of a relatively specialist nature. This can be put to an advantage because the input will be generated from a smaller and, hence, more direct and advanced base of expertise. However, full cognizance of the national dialogue on standards development should be given and the final product therefore submitted with appropriate supporting documentation to the consensus process of standards making. The SERI program for standards development is briefly described. (WHK)

17521 (SERI/TP—313-492, pp 100-103) **STTFUA activities and experiments.** Key, W.P. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The Solar Thermal Test Facilities Users Association was organized in 1977 to promote and enhance the use of the DOE Central Receiver Test Facility at Sandia and Advanced Components Test Facility at Georgia Tech. The UA activities include operation of an office in Albuquerque; organization of workshops to promote research in high-temperature chemistry, physics, materials, and processes at solar test facilities; dissemination of information to potential users of the facilities; technical review of proposals requesting access to the facilities; and recommendation to SERI concerning funding priorities for proposed research at the facilities. Some research efforts proposed are more effectively conducted at a solar furnace type of facility with a horizontal beam as opposed to the two DOE central receiver facilities with upward focused beams. To this end, access agreements were negotiated with the US Army Solar Furnace at White Sands, New Mexico and the French CNRS facility at Odeillo, France. Experiments and planned activities are reviewed. (WHK)

17522 (SERI/TP—313-492, pp 121-123) **Overview of materials development for advanced solar thermal technology program.** Roberts, P.A. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Recently a Solar Thermal Program Office was established at SERI with the responsibility for managing the DOE Advanced Solar Thermal Technology Program. Solar materials research and development is an important part of this program. The Absorber Surfaces Program, as well as other SERI materials research subcontracts are managed within the materials element of the program. The primary goal of the solar materials task is to achieve improvements in the durability, performance and potential reduction in cost of materials for solar thermal applications. Objectives and plans are outlined. (WHK)

17523 (SERI/TP—313-492, pp vp) **Advanced free-piston Stirling engine driven 15 kWe linear alternator program.** Benson, G.M. (Energy Research and Generation, Inc., Oakland, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The objectives of this phase of the program are: (1) design and analyze critical components and subassemblies, (2) assess and optimize the thermodynamic and dynamic performance through computer simulation, and (3) perform a preliminary design of a resonant free-piston Stirling engine (RFPSE) driven 15 kWe linear alternator. Particular emphasis is on: (1) heat exchanger matrices, gas bearings, narrow-clearance seals, control and stability, manufacturability, reliability and production cost of a solar-energized electric power plant employing non-strategic materials. Progress is outlined. (WHK)

CENTRAL RECEIVER

17524 (SERI/TP—313-492, pp 1-4) **Repowering applications.** Taylor, R.W. (SERI, Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

This paper discusses the utility value analysis performed in support of the SERI Repowering Strategy Analysis. Using standard electric utility models, the value of improved hybrid repowered and new 3-hour storage coupled improved stand alone plants are determined for a modified EPRI Synthetic Utility E. The value is determined by combining a dynamic (multi year) generation expansion analysis with a static (single year) production cost analysis. The analysis is performed for various levels and rates of solar thermal penetration. The results indicate that numerous situations exist where the value of heliostats is greater than the cost goals which have been proposed.

17525 (SERI/TP—313-492, pp 1-8) **High-temperature seal development for the SHARE receiver .** Jarvinen, P.O. (Massachusetts Inst. of Technology, Lexington). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The development and experimental demonstration of a high-temperature seal for the SHARE ceramic dome cavity receiver is reported. The mechanical contact seal which was tested on one-foot diameter silicon carbide ceramic dome hardware at pressure differentials to four atmospheres and dome temperaturs to 2200°F (1200°C) showed negligible leakage at expected receiver operating conditions.

DISTRIBUTED COLLECTOR

REFER ALSO TO CITATION(S) 17583, 17587

17526 (SERI/TP—313-492, pp 7-14-) **Heat and electricity from the sun using parabolic dish collector systems.** Truscello, V.C.; Williams, A.N. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Point focus distributed receiver (PFDR) solar thermal technology for the production of electric power and of industrial process heat is discussed and the thermal power systems project conducted by JPL under DOE sponsorship is described. Project emphasis is on the development of cost-effective systems which will accelerate the commercialization and industrialization of plants up to 10 MWe, using parabolic dish collectors. The characteristics of PFDR systems and the cost targets for major subsystems hardware are identified. Markets for this technology and their size are identified, and expect-

ed levelized bus bar energy costs as a function of yearly production level are presented. Finally, the present status of the technology development effort is discussed.

17527 (SERI/TP—313-492, pp 15-19) **Dish-Brayton solar thermal power systems.** Fujita, T. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Performance characteristics are determined for paraboloidal dish solar thermal power systems employing advanced Brayton (gas turbine) power conversion units. The system is comprised of a two-axis tracking dish concentrator with a cavity receiver and Brayton engine-generator assembly at the focal point. The adaptation of Advanced Gas Turbines (AGT) being developed for automotive applications is shown to offer attractive solar system performance at turbine inlet temperatures of the order of 2000°F. Addition of a Rankine bottoming cycle offers higher performance, but with an increase in system complexity and higher cost for the power conversion unit. Comparative analysis indicates that the dish-Stirling system has somewhat greater performance potential since the Stirling engine can achieve higher efficiencies than Brayton systems at lower temperatures. The Brayton engine appears to be lighter than the Stirling and can be coupled to compact advanced-technology generators. Although the comparative assessment of dish-Brayton systems with other dish-engine systems involves many complex tradeoff considerations that are presently being addressed, the first order results indicate that the advanced dish-Brayton system should be recommended for further detailed study and development. A major driver is the potential availability of a low cost, mass-produced AGT for automobiles in the post 1985 timeframe.

17528 (SERI/TP—313-492, pp 20-24) **Dish-Stirling system development.** Stearns, J.W. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The dish-Stirling electric generation system has been identified in previous reviews as a low-noise, pollution-free system with high near-term potential for meeting solar thermal-electric applications needs. Today, with the detailed development of the dish-Stirling system underway, every indication is that original predictions will be met. At the present rate of progress, demonstration of the majority of the basic systems technologies will be done by FY 1981. By FY 1982 we should be able to demonstrate system technology that is capable of 34% solar-to-electric efficiency, has an unattended lifetime potential approaching 100,000 hours, and identifies system installed cost expectations of $500 to $600/kWe in full scale production. Limited production could commence as early as 1984. The systems are designed for hybrid operation, with options for thermal energy storage (TES). These allow a high capacity factor for the system and minimization of fossil fuel consumption.

17529 (SERI/TP—313-492, pp 25-29) **Dish-Rankine SCSTPE program.** Pons, R.L. (Ford Aerospace and Communications Corp., Newport Beach, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The activities planned for Phase II of the Small Community Solar Thermal Power Experiment (SCSTPE) program are summarized. A Dish-Rankine Point Focusing Distributed Receiver (PFDR) solar thermal electric system will be designed and developed and a single power module tested at the JPL Solar Thermal Test Facility, Edwards AFB, California. Major design tradeoffs will center on the choice of steam versus organic Rankine cycle engines. Preliminary performance analyses indicate that a mass-produced Dish-Rankine PFDR system is potentially capable of producing electricity at a levelized busbar energy cost of 60 to 70 mills per kWh.

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 17526

17530 (SERI/TP—313-492, pp 47-50) **Non-heat pipe/P-40 Stirling engine.** Haglund, R.A. (Fairchild Stratos Div., Manhattan Beach, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

This project will demonstrate the technology for a full-up Hybrid Point-Focus Distributed Dish Stirling Solar Thermal Power system by the fall of 1980 at JPL's Desert Solar Test Facility near Lancaster, California. Hybrid operation is provided by fossil fuel combustion augmentation, which enables the Stirling engine to operate continuously at constant speed and power, regardless of insolation level, thus providing the capability to operate on cloudy days and at night. The Non-Heat-Pipe Receiver/P-40 Stirling Engine system will be installed and operated on the JPL Test Bed Concentrator. A 25-kW direct-driven induction-type alternator will be mounted directly to the P-40 engine to produce to a 60-Hz, 115/230-volt output.

17531 (SERI/TP—313-492, pp 51-58) **Heat pipe solar receiver for the Stirling engine.** Zimmerman, W.F. (General Electric Co., Evendale, OH). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A heat pipe solar receiver, with integral latent heat storage provided by a sodium fluoride-magnesium fluoride salt, has been conceived and is under study. The system can readily accommodate fossil fuel hybridization. Design configuration testing on primary heat pipes and secondary heat pipe wicking has been completed successfully and a modular experiment to confirm the performance and define the operating characteristics of the thermal transport and storage systems is ready to start. Further conceptual design studies have indicated that the cost targets in mass production are achievable utilizing oxidation resistant ferritic or austenitic stainless steels, inexpensive high thermal conductivity sialon type ceramic materials and only a minimum use, if any, of super alloys.

17532 (SLAC-PUB—2477) **More on dual purpose solar-electric power plants.** Hall, F.F. (Stanford Linear Accelerator Center, CA (USA)). Feb 1980. Contract EY-76-C-03-0515. 17p. (CONF-791204—33). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Rationale for such plants is reviewed and plant elements are listed. Dual purpose solar-electric plants would generate both electricity and hydrogen gas for conversion to ammonia or methanol or direct use as a fuel of unsurpassed specific power and cleanliness. By-product oxygen would also be sold to owners of hydrogen age equipment. Evolved gases at high pressure could be fired in compressorless gas turbines, boilerless steam-turbines or fuel-cell-inverter hydrogen-electric power drives of high thermal efficiency as well as in conventional internal combustion engines.

OCEAN THERMAL GRADIENT POWER PLANTS

17533 (ORO—5359-1) **Riser segment design of underwater electric power transmission cable system. Final report, September 9, 1977-September 30, 1978.** Bamford, T.B.; Dow, H.H.; Libby, D.O.; Munn, P.S.; Pieroni, C.A.; Traut, R.T. (Simplex Wire and Cable Co., Portsmouth, NH (USA)). Oct 1978. Contract EG-77-C-05-5359. 176p. Dep. NTIS, PC A09/MF A01.

The transmission of electrical power from OTEC generating plants to shore-based power grids requires riser cables that connect the OTEC plant and the bottom cable. The ocean depths anticipated will far exceed the maximum that is the limit of previous high voltage power cable experience. Due to the unique ocean suspension required for these cables, they will also be subjected to motions and forces that have never before been imposed on a high voltage power cable. In view of these factors, this study has examined riser cable support systems, candidate cable types, terminations and connections, installation, maintenance and repair of the system, cost, and overall reliability. Requirements for further development work have also been addressed. None of the problems defined in this study appear to be insurmountable and it is expected that the Phase II development effort will yield viable riser cable system designs.

17534 **Interpretation of oceanographic data for the design of ocean thermal energy conversion plants.** Lewis, L.F. (Energy Research and Development Administration, Washington, DC); Mavor, J.W. Jr. pp 41B.1-41B.7 of Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

The design of an Ocean Thermal Energy Conversion (OTEC) plant requires oceanographic measurements at the specific site to a fine level of detail over a time interval and with a frequency sufficient to assure optimum configuration and performance. A part of the design process is continuous evaluation of the oceanic data and matching it to the needs of design, construction and test. Data include information about oceanic temperature, the occurrence of hurricanes and oceanic eddies, oceanic currents, waves, biofouling, corrosion, and erosion. 16 references.

17535 **High-capacity, deep-water, free-fall anchor.** Atturio, J.M.; Valent, P.J. (NCBC, Port Hueneme, CA). pp 41E.1-41E.5 of Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

Free-falling is being explored as a means of lowering to the seafloor the 33 m (110 ft) diameter, 3 Gg (7 x 10^6 lb) anchors for the US Energy Research and Development Administration's (ERDA) Ocean Thermal Energy Conversion (OTEC) Power Plants. Explora-

tion of the free-fall lowering concept follows selection of the deadweight anchor type, over the pile and drag embedment anchor types, as the best, in general, for OTEC needs. A scaled model of the free-fall, deadweight anchor has been successfully tested at the Civil Engineering Laboratory. The model proved self-righting, totally free of side-slip motion, and nearly free of pitching motion during descent. High lateral load capacity is provided by radial shear keys protruding beneath the anchor base. 5 references.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 17763

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 17569

17536 (ALO—4086-1) **Addition of inexpensive solar air-heaters to a pre-engineered metal building. Final report.** Forbes, R.E.; McClendon, R.W. (Mississippi State Univ., Mississippi State (USA). Engineering and Industrial Research Station). May 1979. Contract EG-77-G-04-4086. 52p. Dep. NTIS, PC A04/MF A01.

At Mississippi State University a research project was begun in 1976 to investigate the use of site-built solar collectors for heating air in poultry houses. The purpose of this work was to design and test a functional air heater solar collector which would be inexpensive to construct and acceptable to poultry producers. The results reported are an extension of the original concept. The basic concept is to use a pre-engineered metal building for the structure and incorporate the solar air heaters as an integral part of the south facing wall of the building. The outer skin of the building is used as the absorber plate for the collctors. Construction and testing of the solar collectors and heat storage systems are discussed, and the performance characteristics of the site-built solar collectors are described. (WHK)

17537 (ANL/EES-TM—63) **HYCSOS: hydride conversion and storage system sensitivity analysis.** Horowitz, J.S. (Argonne National Lab., IL (USA)). Sep 1979. Contract W-31-109-ENG-38. 19p. Dep. NTIS, PC A02/MF A01.

The Hydride Conversion of Solar Energy System (HYCSOS) chemical heat pump has been under development at Argonne National Laboratory since 1975. As part of this work two design studies were performed by TRW. A major part of the more recent TRW study was the development of a computer program to design a HYCSOS system. The work described in this report was to modify and use this program to perform HYCOS sensitivity studies. Although it is recognized that the program used is not entirely correct, it is felt that studies of this kind are valuable for determining the important parameters of the system design. The modified program and results of test studies are discussed. (WHK)

17538 (CONF-790845—, pp 417-418) **Scale models used to simulate passive solar home performance.** Heil, D.R. (Washington State Univ., Pullman). 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

It is intended to reveal the complex concerns an architect has within the realm of passive solar home design. The problem presented is the evolution and maturing of the architectural process by which designers must reconcile technological and humanistic concerns. The author intends to use his own experience and research in the Pacific Northwest to demonstrate how he has worked to solve this problem. To accomplish this end the author constructed a scale model containing sufficient detail so that unknown thermal transfer characteristics could be simulated within the model. A heliodon was used to study the performance of the design with respect to solar penetration, air flow patterns, control mechanisms, and shadows. These studies were recorded on film to provide a document to demonstrate the feasibility of the hypothesis from which the design emerged.

17539 (CONF-791204—31) **Engineering development of a HYCSOS chemical heat pump.** Horowitz, J.S.; Nelson, P.A.; Blomquist, C.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Argonne National Laboratory (ANL) is developing a hydride conversion and storage system (HYCSOS) that is capable of thermal energy storage and space heating and cooling. As a thermal storage medium, metal hydrides provide a high-energy density; however, the economics of such a system are currently unattractive. As a chemical heat pump, a metal hydride system offers the promise of using solar energy, waste heat, natural gas and other energy sources to provide space heating and cooling. The incorporation of an electrical power generation cycle is also a possibility. The HYCSOS chemical heat pump utilizes the heat of absorption and desorption of hydrogen from different metal hydride beds to provide space heating or cooling. In its simplest form, a hydride heat pump consists of two different hydride beds that are interconnected to allow hydrogen gas transfer between them. Past work at ANL has concentrated on demonstrating the feasibility of the concept, and on the development of metal alloys suitable for this application. Recently, an engineering development program has been initiated to study the various system aspects of the hydride chemical heat pump. This study has included conceptual designs of various systems. The engineering development of a heat pump which uses a unique tubular hydride bed that can be cycled rapidly is described. This design features a large number, about 200, of individual tubes. Each tube contains a high temperature hydride at one end, and a low temperature hydride at the other end. The central portion of the tube is designed to allow hydrogen to flow freely between the ends but retard the flow of heat between the ends.

17540 (COO—2705-2) **Solair heater program: solair applications study test program. Final report.** (General Electric Co., Philadelphia, PA (USA)). Dec 1977. Contract EY-76-C-02-2705. 62p. Dep. NTIS, PC A04/MF A01.

Three prototypes of low cost solar forced air heating using evacuated tube collectors for application to hot water and space heating were tested in various climates in the US during the period winter/spring 1976/1977. The data acquisition and data analysis are reported. (MHR)

17541 (COO—2979-3) **Solar assisted heat pump system with volume solar collector. Technical report.** Sabnis, J.S.; Hickox, W.J.; Drucker, E.E.; Ucar, M.; LaGraff, J.E. (Syracuse Univ., NY (USA). Dept. of Mechanical and Aerospace Engineering). Sep 1978. Contract EY-76-S-02-2979. 75p. Dep. NTIS, PC A04/MF A01.

The system uses the attic of the house with a large south facing window as the solar collector. An air-to-water heat pump uses the attic air as a heat source to heat a volume of storage water during the heating season. During the cooling season the attic is ventilated and the heat pump uses the attic air as a heat sink while cooling the storage water. The computer program was developed to include a heat exchanger in the attic which could by-pass the heat pump condenser cooling water, thus permitting direct heat exchange between the attic air and the storage water whenever a favorable temperature existed. The program also accounts for the effect of the incidence angle of insolation and the effect of the number of glass plates on the transmittance and absorptance of the collector and windows. Other refinements include: the use of a sophisticated nighttime setback thermostat, account of internal heat generation and infiltration loss. Among all of the parameter variations, the use of an attic heat exchanger resulted in the maximum savings in the heating/cooling energy consumption of the house. The use of double-glazed windows too, resulted in substantial energy savings. The total energy consumption was found to depend strongly on the infiltration rate. The program was also used to simulate the same system under weather conditions existing at several different geographic areas.

17542 (DOE/CS—0145) **Solar-assisted low energy dwellings. Final report.** Esbensen, T.V. (Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)). Feb 1980. Contract EY-76-S-05-4908. 113p. (CCMS—93). Dep. NTIS, PC A06/MF A01.

The Zero Energy House Group was formed as a subproject of the CCMS Solar Energy Pilot Study in 1974 by seven participating countries experimenting with solar-assisted low-energy dwellings for temperate and northern European climatic conditions. A Zero Energy House is one in which solar energy is used to meet the reduced energy needs of buildings incorporating various thermal energy conservation features. This is the final report of the Zero Energy House Group. It includes brief descriptions of 13 major low-energy dwellings in the participating CCMS countries. An overall assessment of the state-of-the-art in solar-assisted low-energy dwellings is given.

17543 **An arboretum harvests the sun.** D'Alessandro, B. *Sol. Age;* 4: No. 4, 6-10(Apr 1979).

The Cary Arboretum in Millbrook, NY, is a 27,400 ft², two-story structure that was constructed underground with north side berming and seven sawtoothed arrays of solar collectors. The building was constructed with concrete exterior walls, floors, and pedestals for thermal mass and 28 skylights and several windows for natural illumination and heat gain, manually controlled shutters may be drawn when the sun isn't shining to reduce heat loss. The building has an annual design heating demand of 335 million Btu in a climate of 6,700 degree days. The building has a chiller unit that operates as both a heat pump and a refrigeration unit, the 5,650 ft² of collectors heat a water and propylene glycol heat transfer fluid and 15,000 gal of storage are provided in underground tanks. A separate system heats domestic hot water. Several problems with leaking when the system was started up were corrected or are under redesign.

17544 (LA-UR—80-387) **Validation of solar system simulation codes by the International Energy Agency.** Hedstrom, J.C.; Freeman, T.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800101—18). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Validation of active solar energy system simulation codes by the International Energy Agency using data from the Los Alamos Study Center is described. Two rounds of comparisons of predicted to measured performance were completed. In the first round, all participants were given detailed system description data and a period of measured hourly weather and loads data with the corresponding measured hourly performance data. In the second round, the participants were given minor changes to the system description and a second period of measured weather and loads data without the corresponding measured hourly performance. In the first round, each of the participants was able to predict the results provided. However, this required an undocumented series of adjustments to the user input and the models and comparisons of measured and predicted results. Agreement of measured and predicted results were nearly as good in the second round except for two codes that predicted significantly erroneous results. As a result of this exercise, errors and shortcomings have been found and corrected in most of the codes and confidence in the ability of all codes to model real systems has been increased. However, the questions of a workable methodology for validation and the means of dealing with user error remain unanswered.

17545 (LBL—10352) **Experimental test facility for evaluation of controls and control strategies.** Warren, M.L.; Schiller, S.R.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 16p. (CONF-800101—14). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

An experimental test facility has been constructed to evaluate the operation and performance of controls for active hydronic solar energy systems. The experimental system serves to test the relative performance of different controllers and alternative control algorithms for a variety of input meteorological conditions and output load demands. The experimental system consists of a collector loop heat input simulator, a storage tank, a load loop air channel with fan coil, an auxiliary heat source, and associated pumps and valves. The heat input simulator, the pseudo-collector, consists of a boiler with a controlled mixing valve that allows precise adjustment of the heat input from the collectors based on predictions of a collector loop model using solar and weather data. An automated air flow channel has been constructed to simulate the building return airflow across the heating coil in the furnace ductwork for a residential system. A single zone building load model is used to predict building energy requirements and to simulate the demand thermostat. Only the apparent temperature of the collector and the demand thermostat condition are simulated, enabling control strategy and equipment comparisons based on identical load conditions. The test facility is instrumented with thermocouples and turbine flow meters. Data acquisition is accomplished using a one hundred channel DORIC data logger. Data acquisition, experiment control, and the load and pseudo-collector models are under control of a HP 9825A microcomputer using flexible disks for data and program storage.

17546 (SHC—3099) **Availability of solar energy reports from the solar heating an cooling development in support of the demonstration program.** (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Nov 1979. Contract EX-76-A-29-1037. 18p. Dep. NTIS, PC A02/MF A01.

The various types of reports published by Marshall Space Flight Center for DOE on the Solar Heating and Development programs are delineated. The wind prior to October 31, 1979 are listed and order blanks for obtaining copies are included. (MHR)

17547 (SOLAR/0906—79/70) **Reliability and materials performance of solar heating and cooling systems.** Chopra, P.S. (Argonne National Lab., IL (USA)). Jun 1979. Contract W-31-109-ENG-38. 24p. (ANL/SDP-TM—79-8). Dep. NTIS, PC A02/MF A01.

The reliability field information collected to date from the solar heating and cooling systems sponsored by the US Department of Energy (DOE) and the evaluation of four system-reliability problems: freezing, leaks, controls, and collectors are summarized. An example of a reliability analysis for a hot water preheating system is presented using data on component failures obtained primarily from nonsolar sources. The status of Argonne's materials-assessment activities is discussed, along with the results of initial studies of the properties of heat-transfer fluids and the scaling caused by the fluids.

17548 (SOLAR/1001—79/50) **Solar project description for Washington Natural Gas Company's single family residence, Kirkland, Washington.** Beers, D. (Boeing Co., Seattle, WA (USA)). 12 Sep 1979. Contract EX-76-A-29-1020. 48p. Dep. NTIS, PC A03/MF A01.

The solar energy system for a new single family detached residence in Kirkland, Washington, preheats domestic hot water (DHW) and heats 2607 square feet of occupied space. The 546 square foot collector array was manufactured by Solaron Corporation. The collector back is insulated with fiberglass insulation batt, providing an R-12 insulation value. The collector mosaic is installed at a 57°C tilt to the horizontal. These collectors utilize air as heat transfer media and require no freeze protection provisions. The air Thermal Storage Unit consists of a container filled with 27,300 pounds of smooth surfaced stones of 1 to 1 1/2 inch average diameter. The total volume of storage container is 273 (6' x 6' x 7'7") cubic feet. The container has concrete walls and bottom which are insulated with preformed styrofoam panels. The 11 cubic foot water storage tank has fiberglass insulation. Service hot water is preheated by a heat exchanger coil installed in the air duct from the collectors to the air storage. Space heating is provided by air circulation using collectors, storage bin and gas-fired furnace. An Air Handler Unit controls overall air flow in the system. (MHR)

17549 (SOLAR/1018—79/50) **Solar project description for Stewart-Teele-Mitchell single family residence, Malta, NY.** Beers, D. (Boeing Co., Seattle, WA (USA)). 5 Dec 1979. Contract EX-76-A-29-1020. 51p. Dep. NTIS, PC A04/MF A01.

The Stewart-Teele-Mitchell solar energy system is installed in a 1900 square-foot, single family dwelling located in Malta, New York. The system is designed to provide solar energy for space heating, and domestic hot water heating. Solar energy is collected by two banks of flat plate collectors with a gross area of 432 square feet. Solar energy is transferred from the collector array to a 1000 gallon insulated storage tank in the basement. Freeze protection is provided by means of a Glycol-Water solution through the collectors. Auxiliary space heating is provided by an oil fired boiler. Solar energy for heating domestic hot water is stored in a 75-gallon preheat tank and circulates to a conventional 40-gallon domestic hot water heater through a heat exchanger located between the collectors and the solar storage tank. Auxiliary energy for domestic hot water is provided by a natural gas fired DHW tank. (MHR)

17550 (SOLAR/1034—79/50) **Solar project description for Alpha Construction Company's single family residence, Canton, Ohio.** Beers, D. (Boeing Co., Seattle, WA (USA)). 21 Sep 1979. Contract EX-76-A-29-1020. 53p. Dep. NTIS, PC A04/MF A01.

The solar energy system for a new single family detached residence in Canton, Ohio, preheats domestic hot water (DHW) and supplements heating energy for 2460 square feet of occupied space. The solar energy system is designed to provide approximately 50% of the space heating and 70% of the hot water energy requirements for the home. The 432 square foot collector array is installed, in a mosaic pattern, on a slanted roof on the south side of the house. These collectors utilize air as heat transfer medium and require no freeze protection provisions. The air thermal storage unit consists of a concrete container filled with approximately 38,000 pounds of rocks. The domestic hot water preheat storage is a 24 cubic foot (80 gal.) tank with fiberglass insulation. An air-to-water heat exchanger is installed in the preheat storage loop. Space heating is provided by an air circulation loop using air from collectors and/or the thermal storage unit including electric heating elements in a furnace/blower/heat pump combination system. When solar energy is insufficient, a liquid-to-air heat exchanger of a 2.5 ton heat pump and a three-stage electric heater in the air handling unit provides the necessary energy for space heating. (MHR)

17551 (SOLAR/1045—79/50) **Solar project description for Montecito Pines multi-family dwelling, Santa Rosa, CA.** Beers, D. (Boeing Co., Seattle, WA (USA)). 14 Dec 1979. Contract EX-76-A-29-1020. 56p. Dep. NTIS, PC A04/MF A01.

The Montecito Pines solar energy system is installed in a 7600 square-foot, multi-family dwelling located in Santa Rosa, California. The system is designed to provide solar energy for space heating and domestic hot water heating. Solar energy is collected by two banks of double glazed flat plate collectors with a gross area of 950 square feet. Solar energy is transferred from the collector array to a 2000 gallon storage tank. Water is used as the heat collection, transfer and storage medium. Space heating demands are met by circulating water from storage through heating coils in the air distribution system of the house. Auxiliary space heating is provided by a natural gas-fired boiler. Solar energy for heating domestic hot water is provided by circulating water through a heat exchanger located in the 2000 gallon solar storage tank. (MHR)

17552 (SOLAR/1050—79/50) **Solar project description for Bond Construction Company's single family residence, Gladstone, Missouri.** Beers, D. (Boeing Co., Seattle, WA (USA)). 3 Dec 1979. Contract EX-76-A-29-1020. 57p. Dep. NTIS, PC A04/MF A01.

The Bond Construction Company's solar energy system is installed in an approximately 1930 square-foot, three bedroom single family dwelling located in Gladstone, Missouri. The system is de-

signed to provide solar energy for space heating and domestic hot water heating. Solar energy is collected by two banks of liquid flat plate collectors with a gross area of 465 square feet. Solar energy is transferred from the collector array to an 800 gallon storage tank in the basement. Freeze protection is provided by means of circulation antifreeze through the collectors. Overheating protection is provided by venting vapor from storage using collectors as radiators at night, and allowing collectors to boil. Space heating demands are met by circulating water from storage through a liquid to air heat exchanger through the distribution system of the house. Auxiliary space heating is provided by a natural gas fired furnace. Solar energy for heating domestic hot water is provided by transferring water from a storage tank to a conventional 82-gallon domestic hot water heater through a heat exchanger jacket located around the hot water tank. (MHR)

17553 (SOLAR/1057—79/50(Pt.1)) **Solar project description for Zien Mechanical Contractors-I single family residence, Milwaukee, WI.** Beers, D. (Boeing Co., Seattle, WA (USA)). 5 Feb 1980. Contract EX-76-A-29-1020. 48p. Dep. NTIS, PC A03/MF A01.

The Zien Mechanical site is a single family residence located in Milwaukee, Wisconsin. The home has two separate solar energy systems: an air system for space heating and cooling; a liquid system to preheat the potable hot water. Only the heating and cooling modes of operation are covered here. The space heating system is designed to supply approximately 44% of the space heating requirements for the 1388 square foot residence. A fan circulates the solar heated air through the 412.5 cubic foot rock thermal storage, across the heat pump coil, then back to the inlet side of collectors. Auxiliary space heating energy is supplied by 4-kW and 6-kW electric strip heaters. In the summer, the heat pump can also function in the cooling cycle to maintain desired temperatures in the conditioned space. The solar energy system components, heat pump compressor, evaporator, circulating fan, and rock thermal storage are located inside a sealed and insulated room in the house basement. Excessive heat buildup in the rock thermal storage is rejected to the outside ambient either through back-draft damper or through the collectors. (MHR)

17554 (SOLAR/2010—79/50) **Solar project description for Area Health Education Center.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Sep 1979. Contract EG-77-C-01-2522. 41p. Dep. NTIS, PC A03/MF A01.

The solar energy system provides space heating and hot water for the 65,000 square foot, six story educational building in Charlotte, North Carolina, owned by the Charlotte-Mecklenburg Hospital Authority. The building is used for medical research and teaching by health care personnel, and has a library, classrooms, and offices. The 171 aluminum flat plate collectors face south at a 35° angle to the horizontal and have a single LEXAN polycarbonate glazing. The 4020 ft² (gross area) of collectors were manufactured by the General Electric Company. Solar heated water for use in space heating and service water is stored in an underground 6000 gallon hot water tank. Overheat protection is provided by a heat rejector system on the penthouse. Freeze protection is provided by a 50% aqueous solution of ethylene glycol in the piping loop to the solar collectors. Space heating can be provided by circulating the antifreeze solution directly to an air handling unit from the collectors or from a storage loop heat exchanger. A 240 kW electric resistance coil in the air handling unit is used for any additional heating required. (MHR)

17555 (SOLAR/2019—79/50) **Solar project description for Mount Rushmore Visitors' Center.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). May 1979. Contract EG-77-C-01-2522. 53p. Dep. NTIS, PC A04/MF A01.

The solar energy system was retrofitted into the existing 7250 square foot Visitors' Center to heat the entire building and to cool the 2000 square foot Observation Room. The 2016 square foot collector array of Lennox/Honeywell double glazed, selectively coated, flat plate collectors are mounted at a tilt angle of 45° to the horizontal on the sloped roof of the building. Freeze protection for the collector loop is provided by the antifreeze solution. Thermal energy is stored in a 3000 gallon steel storage tank located in the mechanical room. The 7-foot diameter tank, which is 10 1/2 feet long, is insulated with 2 inches of fiberglass. Solar space heating is provided by: (1) circulating the antifreeze solution directly from the collectors to the duct coils in the multi-zone air handling unit; or (2) removing heat from the storage tank to the antifreeze solution in a system-to-storage heat exchanger. Auxiliary space heating is provided by a 550,000 Btu/h, oil-fired boiler. Solar space cooling for the Observation Room is provided by circulating the antifreeze solution from the collectors directly to three 3-ton absorption chillers. (MHR)

17556 (SOLAR/2021--79/60) **Solar project cost report for Irvine Elementary School, Irvine, California.** (Mueller Associates, Inc., Baltimore, MD (USA)). 11 Apr 1979. Contract EX-76-C-01-2398; EG-77-C-01-2522. 32p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is provided for the solar space heating and cooling project at El Camino Real Elementary School in Irvine, California. The system utilizes 180 Owens-Illinois solar collector modules. The modules, each consisting of 24 evacuated, selective surfaced tubes, provide an effective aperture area of 5000 square feet. The collectors are mounted in 18 banks on the flat roof of the building. No storage subsystem is provided in the system. The construction costs of this solar space heating and cooling system are presented. (MHR)

17557 (SOLAR/2033—79/50) **Solar project description for Telex Communications, Inc.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Jul 1979. Contract EG-77-C-01-2522. 47p. Dep. NTIS, PC A03/MF A01.

The solar energy system at Telex Communications, Inc. in Blue Earth, Minnesota utilizes 11,520 square feet of InterTechnology flat plate collectors to supply a portion of the space heating requirements for a 97,000 square foot combination office, warehouse and manufacturing building in Blue Earth, Minnesota. The system utilizes water as a heat transfer medium and has a draindown mode for freeze protection. The storage system consists of a 20,000 gallon steel hot water storage tank. The storage tank is insulated with six inches of fiberglass. Space heating is provided by circulating hot water from storage to twelve, parallel, water-to-air heat exchangers and back to storage. Auxiliary heating is provided by electrical heat strips in each air handling unit and by three electrical space heaters located near the solar space heaters. (MHR)

17558 (SOLAR/2038—79/60) **Solar project cost report for North Hampton Park Recreation and Health Center, Dallas, Texas.** (Mueller Associates, Inc., Baltimore, MD (USA)). May 1979. Contract EG-77-C-01-2522. 36p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is provided for the North Hampton Park Recreation and Health Center solar space heating, cooling, and hot water project located in Dallas, Texas. The system utilizes Lennox-Honeywell liquid, flat plate solar collectors having a gross area of 4280 square feet and a net aperture area of 3660 square feet. The entire solar energy system was retrofitted to the existing building and an additional room was added in order to house much of the solar equipment. The system conditions all of the building except the gymnasium, which utilizes a separate system. Storage for hot water is provided in a 6000 gallon steel tank and for cold water in a 2000 gallon steel tank. The construction costs of this solar project are presented. (MHR)

17559 (SOLAR/2066—79/50) **Solar project description for Billings Shipping Corporation.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Jul 1979. Contract EG-77-F-03-1537; EG-77-C-01-2522. 50p. Dep. NTIS, PC A03/MF A01.

The solar energy system at Billings Shipping Corporation in Billings, Montana utilizes 1980 square feet of Lennox flat plate collectors to supply a portion of the heating requirements for a 4900 square foot office portion of a 43,900 square foot building in Billings, Montana. The system uses a 50% propylene glycol and water solution as the heat transfer medium. The storage system consists of a 2500 gallon steel hot water storage tank, buried approximately five feet below the ground. The tank is insulated with two inches of molded polystyrene beadboard and covered with a six mil polyfilm sheet. Space heating is provided by circulating hot water from storage, or directly from the collectors via the heat exchanger, to a unit space heating coil in the air handling unit. Auxiliary heating is provided by a gas-fired hot water boiler which supplies hot water to a heating coil in series with and downstream of the solar heating coil. The solar energy system has been fully instrumented for performance evaluation and integrated into the National Solar Data Network. (MHR)

17560 (SOLAR/2066—79/60) **Solar project cost report for Billings Shipping Corporation Freight Office, Billings, Montana.** (Mueller Associates, Inc., Baltimore, MD (USA)). Jul 1979. Contract EG-77-F-03-1537; EG-77-C-01-2522. 32p. Dep. NTIS, PC A03/MF A01.

Detailed cost information is provided for the solar space heating project at the Billings Shipping Corporation Freight Office in Billings, Montana. The Billings system uses 110 flat plate liquid collectors, manufactured by Lennox, having a net aperture area of 1660 square feet. Solar energy storage is provided by a 2500 gallon steel water tank buried outside the building. Auxiliary heating is supplied by a gas-fired boiler. The construction costs of this solar heating system are presented. (MHR)

17561 (SOLAR/2069—79/50) **Solar project description for DuCat Investments, Inc., warehouse.** Klein, E. (PRC Energy Analysis Co., McLean, VA (USA)). Aug 1979. Contract EG-77-A-01-4079; EG-77-C-01-2522. 49p. Dep. NTIS, PC A03/MF A01.

The solar energy system was constructed with the new 48,800 square foot warehouse to heat the warehouse area of about 39,000 square feet while the auxiliary energy system heats the office area of about 9800 square feet. The building has 18 bays, and each bay has its own solar system. The 20 collectors for each bay are mounted in a single row. These collectors are double glazed, flat plate collectors and are mounted at 53° to the horizontal. Air is heated either through the collectors or by the electric resistance duct coils. Return air is drawn through the collectors and circulated back into the warehouse space. There is no storage for this system. (MHR)

17562 Solar heating and cooling system. Takeshita, I.; Wakamatsu, N.; Ando, E.; Tanaka, H.; Hozumi, S. (to Matsushita Electric Industrial Co., Ltd.). US Patent 4,178,989. 18 Dec 1979. Priority date 15 Apr 1977, Japan, 10p.

A system is disclosed to accomplish both air cooling and air heating of indoor space by utilizing solar energy. In principle the disclosed system is an absorption refrigeration system, wherein a solution of an evaporable refrigerant in a less evaporable solvent is passed through a solar collector-generator, but the system has additional fluid passages with the provision of changeover valves arranged so as to pass the refrigerant in heated and vaporized state from the collector-generator to an indoor heat exchanger, bypassing the condenser of the refrigerator, thereby to accomplish air heating and return the refrigerant in liquid state from the heat exchanger to the collector-generator, bypassing the absorber of the refrigerator.

17563 Solar energ teaching aid. Burkhart, C.A. US Patent 4,178,699. 18 Dec 1979. Filed date 6 Jul 1978. 4p.

A solar energy teaching aid is disclosed for use in instruction and experimentation to demonstrate the effects and results of active and passive home heating through solar energy. The teaching aid is in the form of a home, one of whose roofs has the largest surface area of any of the surface areas of such home. Such roof has transparent means allowing solar energy to pass therethrough for same to be absorbed by heat sinks, converted to heat energy and stored by such heat sinks, to demonstrate thereby passive collection; and such roof mounts an active collector whose absorber plate absorbs solar energy which is converted into heat energy that heats the internal air in such active collector, to demonstrate thereby active collection.

17564 St. Louis passive premium: a masonry building retrofit. Michels, T. *Sol. Age;* 4: No. 7, 28-32(Jul 1979).

The retrofitting of existing masonry buildings to passive solar heating incorporated the installation of insulation on the building exterior. A house in St. Louis was retrofitted by installing exterior polyurethane rigid board covered with metal lath and stucco to achieve R-18, incorporating a south-facing sun wall, and constructing a cathedral ceiling and an attached greenhouse. The sun wall was constructed by replacing a bay window area with glass and glass ductwork collectors which connect to the greenhouse below. The greenhouse can be disassembled in the spring to prevent overheating problems. An air-lock entry was also installed. The retrofit improvements were estimated to reduce space heating requirements by 80%.

17565 (NMEI—188-88A) **Build a solar greenhouse.** (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). [nd]. 12p. New Mexico Energy Extension Service, Santa Fe, NM.

Directions for the building of an attached solar greenhouse are presented including footings, framing, glazing, and heat storage. Step-by-step instructions are listed. (MHR)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 17526, 17588

17566 (CONF-790845—, pp 345-348) **Solar enhanced oil recovery.** Mills, J.I. (Idaho National Engineering Lab., Idaho Falls). 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

The utilization of currently available solar energy steam production technologies in the steam drive enhanced oil recovery process is discussed. Substitution of solar energy could lead to an increase, by the amount of the substitution, of the total crude oil reserves amenable to recovery using steam drive techniques. In addition, the substitution of currently available solar technologies in the steam drive process would result in an extension of the economic limit appropriate to enhanced oil recovery and a subsequent increase of the number of economically attractive candidate reservoirs. In the current paper, a model solar steam drive thermal system is assumed and sized for a specific thermal load. The total capital cost of the solar system is developed and compared to the total costs of existing fossil-fuel fired steam generating systems of comparable capacity.

17567 (SERI/TP—313-492, pp 5-6) **Implementation of solar industrial process heat.** Kearney, D.W. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Process heat is used in such a diversity of industrial applications that it is misleading to categorize solar industrial process heat (SIPH) as a homogeneous entity. Various studies have been carried out in an attempt to identify the solar potential as a function of standard industrial classifications (SIC codes), quantified by energy use and maximum process temperature in each classification. However, it is becoming increasingly obvious that considerable detail is required for any given industrial use to accurately determine SIPH requirements.

WATER HEATING

REFER ALSO TO CITATION(S) 17540, 17548, 17549, 17550, 17551, 17552, 17554, 17558

17568 (CONF-790845—, pp 138-139) **Heat tape as freeze resistance in a thermosiphon solar water preheater.** Eklund, K.; Siegel, E. (Ecotope Group, Seattle, WA). 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

In 1978 Ecotope Group built and installed four thermosiphon solar water preheating systems in workshops that used electrical resistance heat tape in the collectors as their method of freeze protection. The severe winter of 1978-1979 offered a field situation that provided much information about this approach. Follow-up work has indicated the limitations of the system, patterns of freezing in the collector system, optimum equipment, proper set-up details, and causes of failure. Preliminary work indicates that the optimum use of heat tape in the Pacific Northwest climate is to extend the operational period of a seasonally-drained system into months of possible freezing.

17569 (CONF-791204—30) **Enhancement of low grade heat via the HYCSOS chemical heat pump.** Gruen, D.M.; Sheft, I.; Lamich, G.J. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The Argonne HYCSOS system is a thermally driven chemical heat pump based on two metal hydrides with different free energies of formation that functions in heating, cooling and energy conversion modes. Hydrogen is transferred by means of thermal gradients from one hydride bed to another and the heat released on hydride formation or absorbed on hydride decomposition is available for heating or cooling purposes. With three beds of the same hydride cycling between a higher temperature and a lower one, a continuous supply of high pressure hydrogen can be generated, do useful work in an expansion engine-dynamo unit supplying electricity and then be absorbed on the alloy at a lower temperature. An interesting mode of HYCSOS operation is made feasible by the recent development of a series of ternary alloys whose hydrogen decomposition pressures at a given temperature can be varied by several orders of magnitude. By proper choice of pairs of alloys with properties suitable for the available temperature regime, low grade solar energy, such as can be obtained from inexpensive flat plate collectors in northern climes with low levels of insolation, can be enhanced to provide domestic hot water. Using the $LaNi_5$ and $CaNi_5$ currently in the HYCSOS system, 34 kcal of thermal energy raised the temperature of water from 39°C to 66°C.

17570 (IWR—89) **Solar energy resource potential in Alaska.** Seifert, R.D.; Zarling, J.P. (Alaska Univ., College (USA). Inst. of Water Resources). Mar 1978. 85p. Univ. of Alaska, Fairbanks.

This study concentrated on applying solar energy to domestic hot-water heating needs in Alaska, and an analysis of solar hot-water heating economics was performed using the F-CHART solar energy simulation computer program. Results indicate that solar energy cannot compete economically with oil-heated domestic hot water at any of the five study locations in Alaska, but that it may be economical in comparison with electrically heated hot water if solar collector systems can be purchased and installed for $20 to $25 per square foot.

17571 (SOLAR/1057—79/50(Pt.2)) **Solar project description for Zien Mechanical II single family residence, Milwaukee, Wisconsin.** Beers, D. (Boeing Co., Seattle, WA (USA)). 5 Feb 1980. Contract EX-76-A-29-1020. 44p. Dep. NTIS, PC A03/MF A01.

Zien Mechanical Contractors No. 2 is a single-family residence in Milwaukee, Wisconsin. The home has approximately 1304 square feet of conditioned space. The solar energy system consists of two independently controlled systems: one system is used for domestic hot water (DHW) preheating, the other is used for space heating and cooling. Only the DHW system is described here. The solar energy system has an array of flat-plate collectors with a gross area of 77.6 square feet. Distilled water is the transfer medium that delivers solar energy from the collector array to a conventional 120-

gallon DHW tank. The distilled hot water flows through a tube-in-shell exchanger assembly normally stores the distilled water when it drains from the collector after each collecting cycle. This drain-down feature protects the collectors from freezing damage. Unheated city water is fed directly to the DHW tank, and is supplied, on demand, to the DHW load. When solar energy is insufficient to satisfy the DHW load, an electrical resistance heater in the DHW tank provides auxiliary energy for DHW. No antifreeze additive is required. (MHR)

17572 (SOLAR/2016—79/50) **Solar project description for Loudoun County Vocational Technical Education Center.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Jul 1979. Contract EX-76-C-01-2381; EG-77-C-01-2522. 38p. Dep. NTIS, PC A03/MF A01.

The solar energy system for the Loudoun County School in Leesburg, Virginia, provides solar preheating of the domestic hot water supply for the Charles S. Monroe Vocational-Technical School. The system utilizes 34 Southwest Ener-Tech collectors with a total gross area of 1225 square feet. The collectors face 15° west of south at a tilt angle of 37° from the horizontal. The collectors are ground mounted in one bank in a courtyard surrounded by a brick wall on the north side of the building. The collectors are piped in parallel with one absorber plate and two framed glazings per collector. A solution of Silicone-based oil is used as the heat transfer medium. The working fluid is heated by the collectors and circulated through a heat exchanger in the 2056 gallon solar storage tank. The preheated water from the solar storage tank is then supplied on demand to a smaller (1000 gallon) storage tank. Additional heat is supplied, if required, by an auxiliary electrical heating element in the smaller storage tank. (MHR)

17573 (SOLAR/2056—79/50) **Solar project description for Ingham County Medical Care Facility.** (Mueller Associates, Inc., Baltimore, MD (USA); Ehrenkrantz Group, New York (USA); PRC Energy Analysis Co., McLean, VA (USA)). Aug 1979. Contract EX-76-C-01-2382; EG-77-C-01-2522. 40p. Dep. NTIS, PC A03/MF A01.

Domestic hot water preheating is provided by a solar energy system utilizing 9425 square feet of liquid flat plate collectors. The collectors are double-glazed with tempered glass, have copper absorber plates and a non-selective black coating. A 50% propylene glycol/water solution protects the collectors from freezing down to -20°F. A steam-fired heat exchanger and circulation pump with an emergency generator provide heat to protect the collectors below -20°F. A 5000 gallon, currently uninsulated, steel storage tank, is located in the existing mechanical room. The preheated water in the tank is provided directly to a steam-fired hot water heater for use in the laundry facility. A heat exchanger provides preheated water to a steam-fired domestic hot water heater. A gas/oil fired boiler provides steam to the hot water heaters. (MHR)

17574 (COO—4643-T4) **Solar index generation and delivery. Program plan.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). [nd]. Contract EG-77-C-02-4643. 45p. Dep. NTIS, PC A03/MF A01.

The Solar Index, or, more completely defined as the Service Hot Water Solar Index, was conceptualized during the spring of 1978 with direction from a US Government interoffice agency committee, headed by the Department of Energy. The purpose was to enhance public awareness to solar energy usability. Basically, the Solar Index represents the percentage of energy that solar would provide in order to heat an 80 gallon service hot water load for a given location and day. The Index is computer by utilizing SOLCOST, a computer program, which also has applications to space heating, cooling, and heat pump systems and which supplies economic analyses for such solar energy systems. The Index is generated for approximately 75 geographic locations in the country on a daily basis. The definition of the Index, how the project came to be, what it is at the present time and a plan for the future are described. Also presented are the models used for the generation of the Index, a discussion of the primary tool of implementation (the SOLCOST program) and future efforts.

OTHER

REFER ALSO TO CITATION(S) 17586

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 17525, 17540

17575 (ALO—3713-T1) **Improvement of solar air collectors: Study and Experimental Research Project. Final report, May 1976-June 1978.** Cole-Appel, B.E.; Loef, G.O.G.; Shaw, L.E.; Fischer, B.B. (Solaron Corp., Denver, CO (USA)). 1978. Contract EY-77-C-04-3713. 188p. Dep. NTIS, PC A09/MF A01.

Numerous technical articles that pertain to solar air-heating collectors are summarized and relevant patents are reviewed. The engineering analysis and theoretical considerations that pertain to air-heating collectors are covered. Test results from the first and second phases of testing and the economic analysis of the problem are covered. (MHR)

17576 (ALO—5350-1) **Survey and evaluation of current design of evacuated collectors. Final technical report.** Graham, B.J. (Trident Engineering Associates, Inc., Annapolis, MD (USA)). 30 Sep 1979. Contract EM-78-C-04-5350. 192p. Dep. NTIS, PC A09/MF A01.

The general development of these collectors, is described and a description of numerous evacuated collectors is given which vary from collectors that have been widely used in various applications to others which are still being developed in the laboratory. A table summarizing all of the available collectors, along with their characteristics, is presented. There are four evacuated collectors which have been tested, used in demonstration sites, and developed for the market. These collectors are described in detail, and they are compared in performance and cost with a well-engineered, double glazed, selectively coated, flat plate collector. A rather simple model system of about 2000 ft^2 of collector area for each of the four evacuated collectors and the flat plate collector is described, along with the support structure and the piping for each. Details of the cost are presented in order to compare collector costs with component costs. All of the available efficiency curves of collectors were plotted for comparison with the efficiency curve of a good, flat plate collector. To show the extent of use of evacuated collectors, a list according to manufacturers and to location of all of the sites at which these collectors are being used is presented.

17577 (LBL—10484) **High temperature gas receiver utilizing small particles.** Hunt, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791143—5). Dep. NTIS, PC A02/MF A01.

From Users Association solar fuels workshop; Albuquerque, NM, USA (28 Nov 1979).

The purpose of the work is to develop a new type of solar thermal receiver that utilizes a dispersion of very small particles suspended in a gas to absorb the radiant energy from concentrated sunlight. The Small Particle Heat Exchange Receiver (SPHER) operates by injecting a very small mass of fine, light-absorbing particles into the gas stream. The gas-particle mixture then enters a transparent heating chamber into which the concentrated solar flux is directed. The particles absorb the radiation and because of their very large surface area, quickly transfer the heat to the surrounding gas. The gas-particle mixture continues to heat until the particles oxidize or vaporize. The gas may be heated to medium or high temperatures as suitable for a variety of industrial process heat or thermal power requirements. In particular it can be used as a high efficiency receiver to supply hot air or gas to operate a chemical or fuel production process. Research progress is summarized. (WHK)

17578 (SAND—79-2221) **Technology assessment: line-focus concentrators.** Banas, J.F. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

The current engineering development status of line-focus solar concentrating collectors is described, specifically the parabolic trough, and near-term development emphasis in the areas of structures, reflective materials, receivers, selective coatings, trackers, drives, wind loads, foundations, and field layouts is briefly summarized.

17579 (SAND—80-0583C) **CRTF Real-Time Aperture Flux system.** Davis, D.B. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 11p. (CONF-800502—4). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

The Real-Time Aperture Flux system (TRAF) is a test measurement system designed to determine the input power/unit area (flux density) during solar experiments conducted at the Central Receiver Test Facility, Sandia National Laboratories, Albuquerque, New Mexico. The RTAF is capable of using both thermal sensors and photon sensors to determine the flux densities in the RTAF measuring plane. These data are manipulated in various ways to derive input power and flux density distribution to solar experiments.

17580 (SAND—80-0585C) **Tracking-refinement modeling for solar-collector control.** Biggs, F. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800502—11). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

A closed-loop sun-tracking control used in conjunction with an open-loop system can utilize the unique features of both methods

to obtain an improved sun-tracking capability. The open-loop part of the system uses a computer with clock and ephemeris input to acquire the sun at startup, to provide alignment during cloud passage, and to give an approximate sun-tracking capability throughout the day. The closed-loop portion of the system refines this alignment in order to maximize the collected solar power. For a parabolic trough that utilizes a tube along its focal line to collect energy in a fluid, a resistance wire attached to the tube can provide the sensor for the closed-loop part of the control. This kind of tracking refinement helps to compensate for such time-dependent effects as sag of the absorber tube and deformation of the concentrator surface from gravity or wind loading, temperature gradients, and manufacturing tolerances. A model is developed to explain the behavior of a resistance wire which is wrapped around the absorber tube of a parabolic-trough concentrator and used as a sensor in a tracking-refinement control.

17581 (SERI/TP—313-492, pp 30-40) **Technology assessment: line-focus concentrators.** Banas, J.F. (Sandia Labs., Albuquerque, NM). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Over the past five years, collector/system hardware experiences at Sandia Laboratories within the Solar Thermal Power Systems Program sponsored by the DOE OFfice of Energy Technology have been the following: (1) linear fixed mirror, movable receiver concentrator (GA); (2) linear Fresnel lens concentrator on two axis tracker (MDAC); (3) parabolic dish (Raytheon); (4) linear fixed receiver, movable mirror concentrator (Suntec); (5) parabolic trough (Hexcel); (6) linear fixed mirror, movable receiver concentrator (SA); (7) parabolic trough (Del); (8) moving belt Fresnel mirror concentrator (FMC); (9) parabolic trough (Acurex); (10) parabolic trough (Sandia); (11) MSSTF - 8000 ft^2 collectors, 32 kW/sub e/ total energy plant; and (12) Willard - 14,000 ft^2 collectors, 25 hp irrigation plant. These eleven collectors and two systems were fabricated, tested, and evaluated in order to define engineering development problems requiring solution prior to commercialization initiatives. The major engineering problems and near-term development emphasis are described.

17582 (SERI/TP—313-492, pp 41-46) **Advanced receiver technology.** Kudirka, A.A. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Development of advanced receiver technology for solar thermal receivers designed for electric power generation or for industrial applications is reviewed. The development of this technology is focused on receivers that operate from 1000°F to 3000°F and above. The development program is organized to promote development of innovative and efficient concepts, rather than hardware. Current advanced receiver development projects are categorized in terms of application temperature or function and their status and progress are reviewed.

17583 (SERI/TP—313-492, pp 59-64) **High temperature solar thermal receiver.** Robertson, C.S. Jr. (General Electric Co., Evendale, OH). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A conceptual design has been made for a solar thermal receiver capable of operation in the 1095 to 1650°C (2000 to 3000°F) temperature range. This receiver is designed for use with a two-axis parabaloidal concentrator in the 25 to 150 kW/sub th/ power range, and is intended for industrial process heat, Brayton engines, or chemical/fuels reactions. Three concepts were analyzed parametrically. One was selected for conceptual design. Its key feature is a helical coiled tube of sintered silicon nitride which serves as the heat exchanger between the incident solar radiation and the working fluid. A mechanical design of this concept was prepared, and both thermal and stress analysis performed.

17584 (SERI/TP—313-492, pp 65-68) **High temperature solar thermal receiver conceptual design development.** Davis, S. (Sanders Associates, Inc., Nashua, NH). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Sanders Associates has developed a design concept for a High Temperature Solar Thermal Receiver (HTSTR) to operate at 3 atmospheres and 2500°F outlet. A parametric analysis wherein several receiver types were compared was performed during the first two months of the study. The performance and complexity of windowed matrix, tubeheader, and extended surface receivers were evaluated and the windowed matrix receiver proved to offer substantial cost and performance benefits. Subsequent effort was devoted to definitizing and pricing the receiver as a production unit. The unit has evolved as an efficient (80%) and economical ($20/KWt) receiver for operation at temperatures of 2500°F or less.

17585 (SERI/TP—313-492, pp 69-73) **Development of a solar thermal receiver for high temperature applications.** Bohn, M.; Bessler, G. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A thermal receiver for point focus collectors has been designed and is currently under construction. The design, which was based upon experience with a commercial receiver utilizes some of the advantages of that receiver while making improvements in some of the design features. The new receiver utilizes a thermal mass as a buffer between the cavity surface and the heat transfer fluid. This buffer smooths the heat flux distribution to eliminate hot spots; it does so with a very small temperature drop penalty. Maximum operating temperature range has been extended from 620°C to 870°C and receiver efficiency has been improved significantly. The receiver has a design feature which allows a significant portion of spillage flux at the receiver to be utilized. This makes possible the usage of lower quality optics in applications not requiring very high temperatures. Design and construction features of the receiver are presented and the testing program is described.

17586 (SERI/TP—313-492, pp 104-108) **Update on US Department of Energy Advanced Components Test Facility.** Brown, C.T. (Georgia Inst. of Tech., Atlanta). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The US DOE Advanced Components Test Facility is a 400 kW solar thermal test facility located in Atlanta, Georgia and operated by Georgia Institute of Technology for the US Department of Energy. The facility was first operated in September 1977 against a 300 kW solar steam generation of Italian design. Since that time, various facility modifications have been made and several major test programs have been undertaken. A description of the Facility, a summary of current modifications and research activities, and a summary of test programs planned for calender year 1980 are given.

17587 (SERI/TP—313-492, pp 109-113) **Parabolic dish test site.** Ross, D.L. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A Parabolic Dish Test Site (PDTS) has been established for the Department of Energy (DOE) at the Jet Propulsion Laboratory (JPL) California Institute of Technology's Edwards Test Station (ETS) to provide a site for test and evaluation of solar thermal energy conversion systems and subsystems. ETS was selected because of the high insolation level which is considered one of the best in the United States and because of the excellent meteorological conditions. Described are PDTS capabilities and facilities including the computerized data acquisition and reduction system and circumsolar telescope equipped weather station. Initial tests of the Precursor Concentrator and Omnium-G solar powered electric generating plant are discussed. Also described are two Test Bed Concentrators (TBCs) (installation completed during October 1979) which are scheduled to enter a testing program during November 1979.

17588 (SERI/TP—313-492, pp 114-119) **SERI solar thermal test facilities.** Castle, J.N. (Solar Energy Research Inst., Golden, CO). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Solar thermal test facilities are presently operational at SERI and expanded operations are being planned. Currently, the Interim Field Site is occupied by a point focus collector component evaluation facility (ACRES). A single concentrating collector test installation (STAM) will be added in 1979. All activities will eventually be transferred to a nearby and larger Permanent Field Site. SERAPH, a solar system test facility directed toward industrial process heat applications, will be the first solar thermal test facility at the Permanent Field Site. SERAPH installation will commence in 1980, and by 1982 all field work will be consolidated at the Permanent Site. Research results have already been generated at the existing ACRES facility.

17589 (SERI/TP—313-492, pp 124-128) **Chemical vapor deposition of spectrally selective surfaces for high temperature photothermal solar energy conversion.** Seraphin, B.O. (Univ. of Arizona, Tucson). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

A method is described for the chemical vapor deposition of spectrally selective multilayer coatings of good durability at 500 C. A molybdenum film of high infrared reflectance is overlaid by a solar absorber made of amorphous silicon stabilized against crystallization. Molybdenum films deposited in the presence of an oxygen bleed combine after anneal and passivation a solar absorptance of 0.92 with an infrared emittance of 0.11.

17590 (SERI/TP—313-492, pp 129-134) **Protection of first surface reflectors with silicone resin coatings.** Dennis, W.E. (Dow Corning Corp., Midland, MI). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Silicone resins are being evaluated as protective coatings for first surface aluminum and silver reflectors. The solar weighted hemispherical reflectances and specular reflectances of float glass metallized with silver and aluminum and protected with silicone coatings have been measured. The metallized squares of float glass protected on the front side with silicone resins were highly reflective. The solar weighted reflectances of the silver samples were 5 to 7% higher than the aluminum samples. The reflectances of the aluminized samples were remeasured after 500 hours exposure in an Atlas Filtered Weather-Ometer. Some resin protected samples retained high reflectance and specularity however others lost their specularity. The specularities of the initial samples metallized with silver were poorer than the aluminized samples because of the primer used to improve the adhesion to silver. The most recent silvered samples have good specularity because of better techniques of applying the primer. Work is now in progress to determine the durability of first surface reflectors protected with silicone resins by exposing them to harsh environments including: sulfur dioxide, salt spray, high humidity and natural outdoor weathering.

17591 (SERI/TP—313-492, pp 135-139) **Thin glass for solar application.** Shoemaker, A.F. (Corning Glass Works, NY). 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

Thin glass is divided into two categories in order to isolate problem areas. Thicknesses below 1 mm require additional studies and development in order to enhance cutting, handling, shipping and silvering. Of the several methods available to achieve a curved glass mirror substrate, the use of chemically strengthened glass appears to offer the best combination of features. A new glass has been melted which has been specifically tailored to meet the needs for solar response, environmental hazards and volume production.

17592 (SERI/TP—313-492, pp 140-142) **Effects of soiling and cleanability on solar reflectors.** Carroll, W.F. 1979.

From Semiannual conference for advanced solar thermal technology; Phoenix, AZ, USA (11 Dec 1979).

The performance of highly concentrating solar energy conversion systems can be adversely affected by accumulation of contaminants on reflector surfaces. Without artificial cleaning, glass mirrors in remote areas with frequent rain will degrade rapidly to a broad-band equilibrium with a mean value of approximately 10% loss; over extended periods, this equilibrium continues to degrade. Other data indicates that the degradation of polymer mirrors in remote areas, glass mirrors in urban areas, and all mirrors in remote areas during extended rainless periods could be several times greater. Artificial cleaning may be required, depending on system operation, material and location and must be optimized to minimize energy cost. This report summarizes key results of a recent soiling workshop.

17593 **Cascade solar fluid heater.** Ward, J. (to Jessop Enterprises Pty. Ltd.). US Patent 4,180,057. 25 Dec 1979. Filed date 16 Sep 1977. 4p.

The solar water heater is positioned in an inclined manner with an inlet at the upper portion and an outlet at the lower portion so that the water flows downwardly over a series of corrugations extending transversely to the direction of flow of water, the water spilling over each corrugation in turn.

17594 **Laminar solar energy collecting unit having absorber plates consisting of hollow fibers.** Schnabel, R.; Hussmann, E. (to JENAer Glaswerk Schott and Gen.). US Patent 4,180,056. 25 Dec 1979. Priority date 26 Apr 1976, German, Federal Republic of (F.R. Germany), 14p.

A solar energy collecting unit is disclosed having an absorber for solar radiation comprising at least one hollow fiber having a heat-dissipating medium flowing therethrough. The hollow fibers used are preferably glass fibers, and preferably form the absorbing surface of the collecting unit.

17595 **Solar-heat collector.** Hudnall, W.E. US Patent 4,180,055. 25 Dec 1979. Filed date 3 Jan 1978. 6p.

A solar-heat-collector apparatus is disclosed providing a means for gathering and concentrating solar radiation at a maximum collecting rate, regardless of the incident angle of the solar radiation impinging on the apparatus. The apparatus comprises an outer housing and an inner housing arranged in spaced relation to each other - forming an insulating gap therebetween. Disposed within the second housing is a continuously arranged solar-pipe system on which is affixed compatible, molded, heat-abosrbing, finned bodies wherein the fin members thereof extend radially outward in a longitudinal array of panels arranged at various angular degrees about the pipe to increase the radiation impinging area, so as to receive the maximum solar energy as it enters through either side of the transparent housing at any given angular displacement. The apparatus can be positioned to receive solar radiation simultaneously from both sides when a parabolic reflector unit is so positioned to reflect the solar radiation to the side not directly exposed to solar radiation.

17596 **Solar collector.** Goolsby, P.F.; Laudig, D.J.; Mechler, P.A.; Osterhus, S.J.; Swenck, G.F. (to Reynolds Metals Co.). US Patent 4,178,909. 18 Dec 1979. Filed date 1 May 1978. 10p.

A solar collector is provided comprising a cover assembly which employs a flexible polymeric cover sheet and means for stretching the cover sheet and maintaining it taut under various ambient temperature conditions, a simple and economical peripheral supporting structure, and support means for a solar heat exchanger of the solar collector which supports such heat exchanger in a high strength manner yet in thermally insulated relation.

17597 **Solar energy collector system.** Popplewell, J.M. (to Olin Corp.). US Patent 4,178,990. 18 Dec 1979. Filed date 15 Nov 1977. 8p.

The invention relates to an improved aqueous solar energy collector system which includes a heat exchange panel wherein a getter having a surface layer in contact with the aqueous fluid which is characterized by a high affinity for corrosive metal ions in the aqueous fluid is provided upstream of the heat exchangers to thereby remove said corrosive ions from the aqueous fluid before it is introduced into the heat exchanger.

17598 **Solar collector system.** Hutchison, J.A. (to Solar Kinetics, Inc.). US Patent 4,178,913. 18 Dec 1979. Filed date 23 Dec 1977. 16p.

An improved solar collector system includes a moveable surface to receive solar radiation. The moveable collector surface is supported by at least one load bearing universal joint. The movement of the collector surface is accomplished by a hydraulic actuated tracking system to enable the collector surface to be oriented toward the sun to achieve maximum solar energy recovery. The hydraulic actuated tracking system includes at least two hydraulic cylinders and pistons whereby the primary piston and cylinder control the position of the secondary piston and cylinder which, in turn, control the orientation of the collector surface.

17599 **Solar energy heat collector.** Mattson, J.P. (to Solarspan Inc.). US Patent 4,178,911. 18 Dec 1979. Filed date 21 Dec 1977. 6p.

An apparatus is disclosed for collecting radiant solar energy to provide solar heating which may be used singly or in multiples as modular units. The apparatus is constructed as a self-contained unit having an insulated base, an energy receiving surface positioned adjacent the insulated base, and a heat exchange fluid conduit for circulating a heat exchange fluid in contact with the energy receiving surface. Other conduits are provided to introduce a heat exchange fluid and to receive or collect the fluid after it has been in contact with the energy receiving surface. The top or cover of the collector module is positioned in spaced relationship adjacent the energy receiving surface. The cover is transparent to solar energy and is provided with a plurality of spaced raised structures having surfaces angularly disposed to transmit radiant solar energy to the energy receiving surface. Side walls provide a self-contained unit and permit mounting of the unit on a surface.

17600 **Solar collector and system for mounting a plurality of solar collectors on a surface.** Gramer, E.J.; Johnson, M.O. US Patent 4,178,910. 18 Dec 1979. Filed date 8 Jul 1977. 16p.

The invention involves solar energy collecting units and a system for mounting such units on a support surface. Each unit has a solar radiation collecting panel through which a heat transferring fluid such as water can pass. Each panel can be connected to the panel of adjacent units so that the heat transferring fluid can pass among a series of units as it is being heated. A tapered fluid inlet manifold is provided at one end of the solar collecting panel with a similar tapered fluid outlet manifold at the opposite end. An inlet tube is in communication with the inlet manifold and an outlet tube is in communication with the outlet manifold. Male-female couplings are provided about the respective inlet and outlet tubes so that adjacent solar collecting units can be easily and quickly connected. The tapered manifolds allow the fluid to drain quickly and completely out of whichever end of the collector panel is lower when the panel is not in use. A unique system for coupling the inlet and outlet tubes is provided to allow for expansion and contraction of the units during radical temperature fluctuations. Each solar collecting unit is mounted by flange members extending along the sides of the unit and separate longitudinal clamps to mounting rails aligned in parallel relationship on the supporting surface. The unique mounting system of the invention secures a plurality of the units onto the supporting surface to form an efficient solar energy collecting system. Each unit weighs about the same as standard roofing and the assembly of the units will completely cover and protect the supporting surface.

17601 Evacuated-tube solar collector. Novinger, H.E. US Patent 4,177,794. 11 Dec 1979. Filed date 5 May 1978. 6p.

This invention provides for an unusually efficient, lightweight, economical and durable solar collector employing a fibrous absorber in an evacuated-tube type solar collector. The depth of the absorber, measured in centrimeters more efficiently traps radiation than the shallow depth of a plate absorber surface. The fibers are arranged in irregular order with space for a fluid. Sufficient fiber mass is used to blanket all radiation. The absorber is disposed inside the inner tube of a two tube collector. The second tube fits about the inner tube in a manner that allows the space between the walls of the tubes to be evacuated of air. A reflector may be disposed inside the lower half of the outer tube to improve efficiency. A fluid enters one end of the coilector and passes via ducts through the absorber conducting heat from the highly radiation absorptive fibers and exits the other end. The fiber may be compressed to opacity and a tube fitted within the ducts for the heating of another fluid in the tube.

17602 Aluminium or copper substrate panel for selective absorption of solar energy. Roberts, M.L.; Sharpe, M.H.; Krupnick, A.C. (to National Aeronautics and Space Administration). US Patent 4,177,325. 4 Dec 1979. Filed date 30 May 1978. 8p.

A panel for selectively absorbing solar energy is disclosed comprising an aluminum substrate, a layer of zinc thereon, a layer of nickel over the zinc layer and an outer layer of solar enrgy absorbing nickel oxide or a copper substrate with a layer of nickel thereon and a layer of solar energy absorbing nickel oxide distal from the copper substrate. A method for making aforesaid panels is disclosed.

17603 Eyewitness report on collectors - architectural concerns in solar system design and installation. Weinstein, S. *Sol. Age;* 4: No. 9, 39-43(Sep 1979).

Architectural considerations in the mounting of solar collectors and solar energy system design are discussed. For flat roofs, recommendations for the configuration and spacing of vertical collector support structures are reviewed. The building's material structure will have an effect on the collector supports which include round aluminum tube space frame, square steel tube space frame, and hot rolled standard steel sections in beam construction. Anchorage configurations must consider dead loads, horizontal thermal movement, and snow and wind loads, configurations illustrated include pitch pockets, field fabricated or prefabricated curbs, neoprene sleeves, sleepers, guy wire anchorage, supports between walls, and dead load anchors. Drain-down designs and sleeper locations are discussed for pitched roofs. Footings, horizontal structures, and pole barn constructions are reviewed for ground mounted collector arrays.

17604 Solar heating panels. Marles, K.C.; Spencer, B.W. (to Solar Apparatus and Equipment Ltd.). US Patent 4,164,935. 21 Aug 1979. Priority date 6 Oct 1976, United Kingdom of Great Britain and Northern Ireland (UK), 10p.

A solar heating panel is constructed from a kit of parts which essentially comprises a number of absorber plate sections, each of which has on one edge an outwardly-facing concave part-cylindrical portion, the concave surface of which has a radius of curvature equal to the radius of curvature of the outside circumferential surface of the tubes which will carry the water to be heated through the panel. In the embodiment described, the part-cylindrical portions on the absorber plate sections are clamped with their concave surfaces in heat-conducting contact with the outer surfaces of the tubes by spring clips which are readily snapped over the convex surfaces of adjacent absorber plate sections. The heat-conducting contact between the concave surfaces on the part-cylindrical portions of the absorber plates and the outer surfaces of the tubes may be either an intimate surface contact between essentially smooth surfaces, or it may be a contact through a film of a heat-conductive paste which ensures a substantial exclusion of air or mositure from between the two curved surfaces. 5 claims.

17605 Glazing: the choice affects appearance, performance, cost. Temple, P., Kohler, J. *Sol. Age;* 4: No. 4, 25-29(Apr 1979).

An evaluation of the various materials suitable for glazing materials on solar collectors is presented. Properties required of glazing materials include: resistance to degradation by light, heat, and weather, high solar radiation and low infrared transmittances, low cost, ease of handling and fabrication, and aesthetic suitability. Glass, fiberglass-reinforced polyester, plastic films, rigid plastics, and insulating panels as glazings were evaluated. Various brand-name glazing materials were compared for thickness, cost, transmittance, weight/area, thermal expansion, ease in handling, strength, and sheet size. Manufacturers of solar collector glazing materials are listed.

HEAT STORAGE

17606 (CONF-791204—25) Modelling of a two-tank seasonal storage system for solar space heating of buildings. Cha, B.C.; Mueller, R.O. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 4p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

A novel two-tank storage system is discussed consisting of a large seasonal storage tank for summer collection, and a diurnal storage tank for collection of solar energy during the winter heating season. An approach to simulation of the system has been developed and is described. It includes modelling of a flat-plate collector, the two fully-mixed storage tanks, two load heat-exchangers, storage tank losses, auxiliary furnace, and control strategy. (MHR)

17607 (DSE—4275-T1) Solar applications of thermal energy storage. Final report. Lee, C.; Taylor, L.; DeVries, J.; Heibein, S. (Hittman Associates, Inc., Columbia, MD (USA)). Jan 1979. Contract EM-78-C-01-4275. 157p. Dep. NTIS, PC A08/MF A01.

A technology assessment is presented on solar energy systems which use thermal energy storage. The study includes characterization of the current state-of-the-art of thermal energy storage, an assessment of the energy storage needs of solar energy systems, and the synthesis of this information into preliminary design criteria which would form the basis for detailed designs of thermal energy storage. (MHR)

17608 (SERI/TP—333-497) SERI Solar Energy Storage Program. Copeland, R.J.; Wright, J.D.; Wyman, C.E. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract EG-77-C-01-4042. 12p. (CONF-791232—1). Dep. NTIS, PC A02/MF A01.

From Thermal energy storage review meeting; Tysons Corner, VA, USA (3 Dec 1979).

The SERI Solar Energy Storage Program provides research on advanced technologies, system analyses, and assessments of thermal energy storage for solar applications in support of the Thermal and Chemical Energy Storage Program of the DOE Division of Energy Storage Systems. Currently, research is in progress on direct contact latent heat storage and thermochemical energy storage and transport. Systems analyses are being performed of thermal energy storage for solar thermal applications, and surveys and assessments are being prepared of thermal energy storage in solar applications.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 17627, 18093

17609 (EPRI-WS—79-166, pp 4.38-4.41) Gulf Coast geopressured geothermal energy: Summary of research at the University of Texas at Austin. Lamb, J.P. (Univ. of Texas, Austin). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The general organizational framework of the geopressured-geothermal program is shown. The following areas of investigation are described briefly: geological assessment, entrained methane, environmental impacts, sandstone diagenesis, elastic rock properties, resource engineering, resource utilization, legal and institutional studies, operations research, and geopressured geothermal conferences. (MHR)

17610 (EPRI-WS—79-166, pp 5.17-5.20) Overview of DOE-sponsored geothermal technology development. McFarland, C.B. (Dept. of Energy, Washington, DC). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The Technology Development Program is divided into five areas: drilling and completion technology; energy conversion systems and reservoir stimulation; geochemical engineering and materials; geosciences; and hot dry rock. The approximate funding levels in these five areas for years FY 1978 through FY 1980 are shown. A brief description of each program is given. (MHR)

RESOURCE STATUS AND ASSESSMENT

17611 (EPRI-WS—79-166, pp 7.3-7.7) Impact of R and D on geothermal development. Black, R.A. (Dept. of Energy, Washington, DC). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The impact research and development is expected to have on geothermal exploration, feasibility studies, drilling costs, and the cost of energy conversion components is discussed. (MHR)

USA

17612 (EPRI-WS—79-166, pp 4.28-4.30) **Utility participation in Raft River.** Johnson, V.V.; Turner, J.R. (Geothermal Power Development Group, Boise, ID). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The background of the Raft River Valley project is reviewed briefly. The utility involvement, interim agreement, and the operation and maintenance agreement are discussed. (MHR)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

17613 (LA—8222-HDR) **Bibliography of the geological and geophysical aspects of hot dry rock geothermal resources.** Heiken, G.; Sayer, S. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 52p. Dep. NTIS, PC A04/MF A01.

This is the first issue of an annual compilation of references that are useful to the exploration, understanding and development of the hot dry rock geothermal resource.

USA

17614 (DOE/ET/28392—33) **Geology map of the San Emidio, Nevada geothermal area.** Moore, J.N. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Dec 1979. Contract EG-78-C-07-1701. 30p. Dep. NTIS, PC A03/MF A01.

Since mid-Tertiary time, the rocks on the eastern edge of the San Emidio Desert have undergone extensive hydrothermal alteration. The most recent alteration has produced intense acid leaching and small native sulphur deposits along a steeply dipping range front fault. These deposits reflect the continued evolution of hydrogen sulfide from near-surface thermal fluids related to a presently active hydrothermal system. The absence of recent igneous activity, the close association between the thermal fluids and range front faults, and the limited distribution of active thermal features suggest that the thermal fluids represent deep circulation of meteoric water.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

17615 (EPRI-WS—79-166, pp 2.31-2.37) **Geophysical methods in reservoir engineering and reservoir management.** Meidav, T. (Woodward-Clyde Consultants, Berkeley, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The geoscientific techniques are summarized which provide useful data in estimating reservoir size, temperature, and its volume of heat which is theoretically tappable prior to any extensive field development through deep drilling. Those techniques which are valuable for monitoring the field during exploration are shown. A listing of techniques which are valuable in making strategy decisions while drilling production holes is also presented. The discussion is restricted to those techniques which are related to reservoir monitoring during field exploitation only. (MHR)

17616 (IDO—77.3.1) **Three dimensional magnetotelluric modeling. Final: volume 77-15.** Hohmann, G.W.; Ting, S.C. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jul 1978. Contract EY-76-S-07-1601. 54p. Dep. NTIS, PC A04/MF A01.

A three-dimensional (3D) volume integral equation solution was refined and adapted to magnetotelluric (MT) modeling. The refinement, incorporating an integro-difference scheme, increases the accuracy somewhat without increasing the computer time. Utilizing the two symmetry planes for a plane wave source decreases the computer storage by a factor of 8 and greatly reduces the computer time. Convergence checks and comparisons with other solutions show that our results are valid. Because of space charges at resistivity boundaries, low-frequency 3D responses are much different from 1D and 2D responses. Hence 3D models are required for interpreting MT data in the complex geothermal environment.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 17976

17617 (LA—8211-MS) **Geothermal well log interpretation state of the art. Final report.** Sanyal, S.K.; Wells, L.E.; Bickham, R.E. (Stanford Univ., CA (USA). Petroleum Research Inst.; Scientific Software Corp., Denver, CO (USA)). Jan 1980. Contract W-7405-ENG-36. 330p. PC $18.50/MF $3.50.

An in-depth study of the state of the art in Geothermal Well Log Interpretation has been made encompassing case histories, technical papers, computerized literature searches, and actual processing of geothermal wells from New Mexico, Idaho, and California. A classification scheme of geothermal reservoir types was defined which distinguishes fluid phase and temperature, lithology, geologic province, pore geometry, salinity, and fluid chemistry. Major deficiencies of Geothermal Well Log Interpretation are defined and discussed with recommendations of possible solutions or research for solutions. The Geothermal Well Log Interpretation study and report has concentrated primarily on Western US reservoirs. Geopressured geothermal reservoirs are not considered.

17618 (SAN—1309-3) **Mechanical refrigerator for deep well sonde electronics, Phase II. Final report.** Fukuzawa, J. (System Development Corp., Santa Monica, CA (USA)). 9 Apr 1979. Contract EY-76-C-03-1309. 127p. Dep. NTIS, PC A07/MF A01.

The system is based on a vapor cycle refrigeration system with the usual compressor, evaporator and condenser. It is designed to operate between a condensing temperature of 275°C and an evaporating temperature of 125°C. Water vapor is the refrigerant. The compressor is an electric motor driven three-stage positive displacement machine. The design output of the refrigerator is 50 watts cooling. The work described covers the development of the compressor with associated component development tests. The compressor was tested in a loop simulating downhole conditions. Short duration runs were accomplished where study state conditions of refrigerant and lubricant flows were established. However, because of various component failures, sustained operations, greater than 6 hours at a time, could not be made. (The design goal was 100 hours.)

17619 (SAND—80-0379C) **Semiconductors for high temperature active devices: silicon, GaAs, and GaP.** Coquat, J.A. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800504—1). Dep. NTIS, PC A02/MF A01.

From Electro/80 professional program meeting; Boston, MA, USA (13 May 1980).

Portions of document are illegible.

This paper reviews developments during the past three years in the area of high-temperature active semiconductor devices for use at 275°C in instrumentation needed to characterize geothermal resources. Surveys of silicon bipolar, MOS, and JFET devices operated at high temperature and development work on high temperature silicon CMOS logic and DI analog circuits are reviewed. The initial results of developmental work on GaAs and GaP diodes are discussed. These efforts have identified several promising devices for high temperature applications; however, further development is required to resolve such problems as excessive leakage currents, metallization degradation, device stability, and long term aging.

LEGAL AND INSTITUTIONAL ASPECTS

17620 (EPRI-WS—79-166, pp 1.5-1.6) **Role of new energy resources.** Bos, P.B. (Electric Power Research Inst., Palo Alto, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The organization and funding of the Electric Power Research Institute is described. The work of the New Energy Resources department, which includes geothermal energy, is discussed. (MHR)

17621 (EPRI-WS—79-166, pp 7.16-7.18) **Geothermal R and D demonstration projects: how they can serve the needs of the California Energy Commission.** Reed, C.S. (California Energy Commission, Sacramento). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The California Energy Commission is responsible for regulating the siting of all power plants over 50 MW and for conducting R and D to accelerate the development of alternative energy resources. Current research projects and the regulatory program in the future are reviewed. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

17622 (DOE/RA/4713—1) **Geothermal investment and policy analysis with evaluation of California and Utah resource areas.** Cassel, T.A.V.; Edelstein, R.H.; Blair, P.D.; Amundsen, C.B. (Technecon Analytic Research, Inc., Philadelphia, PA (USA); Pennsylvania Univ., Philadelphia (USA)). Oct 1979. Contract ET-78-S-02-4713. 160p. Dep. NTIS, PC A08/MF A01.

A geothermal investment decision model was developed which, when coupled to a site-specific stochastic cash flow model, estimates the conditional probability of a positive decision to invest in the development of geothermal resource areas. The geothermal

cash flow model, the investment decision model and their applications for assessing the likely development potential of nine geothermal resource areas in California and Utah are described. The sensitivity of this investment behavior to several policy incentives is also analyzed and discussed.

17623 (EMD—80-26) **Geothermal Loan Guarantee Program: need for improvements.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 24 Jan 1980. 51p. General Accounting Office, Washington, DC.

The progress and management of the Department of Energy's geothermal loan guarantee program are discussed. Recommendations for improving the program and matters for consideration by the Congress are included. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 18084

17624 (EPRI-WS—79-166, pp 1.2-1.4) **Geothermal energy: promise of research and the certainty of development.** Daines, N.H. (Pacific Gas and Electric Co., San Francisco, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Experience at the Geysers is reviewed. How research has lagged behind development is discussed with emphasis on hydrogen sulfide abatement. Testing upstream abatement systems is mentioned. (MHR)

17625 (EPRI-WS—79-166, pp 3.22-3.26) **Upstream removal of H_2S from geothermal steam.** Coury, G.E. (Coury and Associates, Inc., Lakewood, CO). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

A process is under development for removal of more than 90 percent of H_2S and other noncondensable gases from geothermal steam upstream of electrical generating equipment. The process involves condensation and re-evaporation of the steam in a single heat exchanger unit. Noncondensable gases are separated from the condensate, to be either reinjected or processed for alternative means of disposal of the H_2S.

17626 (EPRI-WS—79-166, pp 3.27-3.31) **Analytical results, copper sulfate method of upstream H_2S removal.** Brown, F.C. (EIC Corp., Newton, MA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Scrubber chemistry and efficiency were found to be highly dependent on process conditions. With respect to The Geysers average conditions, scrubbing efficiency is generally higher at higher pressures. At lower pressures, longer contact times, higher pH's, or higher copper concentrations are required to achieve comparable results. The solids produced at the maximum and minimum pressures tested showed essentially the same liquid solid separation characteristics: settling was rapid and overflow clarity excellent. However, the solids produced at lower scrubbing pressures proved to be significantly easier to regenerate than those found at high pressures. In all cases tested, regeneration conditions were relatively mild, and near quantitative recovery of precipitated copper was obtained.

17627 **Pollution perspective for geothermal energy development.** Hartley, R.P. (Environmental Protection Agency, Cincinnati, OH). pp 243-248 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The exploitation pattern in geothermal energy is similar to that for fossil fuels. First sought are easily accessible, high quality resources with long-term, low-cost, high-volume production potential. Geothermal resources with these initial attributes are relatively rare and exist as reservoirs of very hot water or steam. Because they are usually in remote places, the emphasis is on conversion of the heat energy to transportable electricity. Secondary, but apparently increasing in importance, is the potential use of more plentiful lower temperature resources for direct heating applications. Dry steam resources are rare but the only US power generation facility at the Geysers, California, operates on this type. Future development potential is highest for hot water resources. Potential pollution varies widely among reservoirs and uses. Hydrogen sulfide releases and wastewaters high in dissolved solids are the principal potential sources of pollution. Wastewater characteristics will be much the same as the natural reservoir fluid characteristics and will be relatively constant for a given reservoir - an advantage in designing treatment and disposal systems. Two control technology areas have evolved as those of prime concern, treatment of noncondensible gases and subsurface injection of wastewater. The latter, if successful, would eliminate the need for wastewater treatment and aid in reservoir maintenance and subsidence control. Present geothermal development is dealing first with highly mineralized resources, which should make ensuing development of cleaner resources much easier.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 17625

17628 (EPRI-WS—79-166) **Proceedings of the third annual geothermal conference and workshop.** (Altas Corp., Santa Cruz, CA (USA)). Oct 1979. 226p. (CONF-790679—). Dep. NTIS, PC A11/MF A01.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Two papers were abstracted previously. Separate abstracts were prepared for the other papers, except for the welcoming address and the panel summary reports. (MHR)

17629 (EPRI-WS—79-166, pp 1.7-1.8) **EPRI Geothermal Program.** Roberts, V.W. (Electric Power Research Inst., Palo Alto, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The philosophy and rationale that underlie the EPRI Geothermal Program are discussed. Binary cycle, direct flash, and geopressured resource development are mentioned. (MHR)

17630 (EPRI-WS—79-166, pp 6.15-6.20) **DOE-sponsored geothermal technology development.** McFarland, C.B. (Dept. of Energy, Washington, DC). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

An overview of the hydrothermal electrical R and D program is presented. Following a brief review of the economics of geothermal electrical utilization, the possible strategies for reducing the cost and increasing the availability of geothermal electricity are discussed. A statement of the objectives and strategy of the R and D program is presented next. This is followed by a description of various program areas. Finally, an estimate of the expected impact of a successful R and D program on the cost of geothermal electricity is presented.

17631 (EPRI-WS—79-166, pp 7.1-7.2) **Research and development needs.** Berge, C.W. (Phillips Petroleum Co., Salt Lake City, UT). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Needs in technical research are reviewed, including elastomers, pumps, and well stimulation. Also mentioned are smaller power plants, the helical screw expander, pricing, and risk assessment. (MHR)

17632 (EPRI-WS—79-166, pp 7.8-7.10) **Research and development needs of geothermal systems from the viewpoint of a plant designer.** Hathaway, W.M.; Tanner, A.L. (Fluor Engineers and Constructors, Inc., Irvine, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The present generation of geothermal power systems are defined and the nature of the next is indicated. Projects for vapor-dominated and hot-water systems are discussed separately. (MHR)

17633 (EPRI-WS—79-166, pp 7.11-7.13) **Geothermal R and D needs.** Lacy, R.G. (San Diego Gas and Electric Co., CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Utility R and D needs include pilot plant and commercial-scale development. Operational needs are mentioned. (MHR)

17634 (EPRI-WS—79-166, pp 7.14-7.15) **Research and development needs for second generation geothermal power plants.** Moore, J.B. (Southern California Edison Co., Rosemead). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Actions taken by Southern California Edison in the geothermal energy field are reviewed. Reliability, maintenance, downhole pumping, Rankine cycle, and direct contact and fluidized bed heat exchangers are mentioned. (MHR)

DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 17648

17635 (EPRI-WS—79-166, pp 2.9-2.15) **Heber Geothermal Demonstration Power Plant: baseline design RP5802.** Unitt, S.G. (Fluor Engineers and Constructors, Inc., Irvine, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Several utilities and public agencies joined in a common objective to construct, operate, and evaluate a commercial size binary cycle geothermal power plant. Because of the economic risks associated with this first-of-a-kind plant, funding could not be obtained and the project was terminated. The optimized baseline design is described including the operating plan, power cycle, auxiliary systems, performance features, and power cost estimate. The power plant plot plan, preliminary electrical diagram, power cycle schematic, and an optimized power cycle are shown. (MHR)

17636 (EPRI-WS—79-166, pp 2.24-2.30) **Performance evaluation of Magma 11.2MWe Binary Plant.** Pundyk, J.M. (PFR Engineering Systems, Inc., Marina del Rey, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The main process loops, the instrumentation, main equipment, and other subsystems are reviewed. The elements of the data acquisition system are listed. (MHR)

17637 (EPRI-WS—79-166, pp 4.34-4.37) **Development plans for the Baca Demonstration Program.** Maddox, J.D. (Public Service Co. of New Mexico, Albuquerque). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The US Department of Energy announced on July 6, 1978 that it had selected the Baca Geothermal Demonstration Project for cooperative development as proposed by Union Oil Company and the Public Service Company of New Mexico. In accordance with the proposal, Union will drill the required wells and will construct and operate the pipelines, separators and other surface facilities required to supply clean dry steam to the generating plant. The generating plant will be constructed and operated by PNM. PNM will also construct the transmission facilities required to connect the plant to the company's existing transmission network. The total cost of the project, including operating and maintenance costs during the first five years of demonstration operations, is estimated to be slightly less than $125 million. Of this amount, DOE has been asked to contribute a maximum of approximately $56 million. The balance of future project costs will be incurred approximately equally by Union and PNM.

17638 (EPRI-WS—79-166, pp 2.16-2.23) **Assessment of direct flash geothermal power plant reliability.** Alt, T.E. (Arizona Public Service Co., Phoenix). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The history of the development at Cerro Prieto geothermal field is reviewed. The facility and the available technical information are discussed. Well completion, well operation, pipelines, and power plant operation are described. (MHR)

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 17626

17639 (EGG-FM—5087) **Short-term pilot cooling tower tests.** Suciu, D.F.; Miller, R.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1980. Contract EY-76-C-07-1570. 47p. Dep. NTIS, PC A03/MF A01.

Two major problems are associated with the use of cooled geothermal water as coolant for the 5 MW(e) pilot plant at Raft River. They are: (1) a scaling potential owing to the chemical species present in solution, and (2) the corrosive nature of the geothermal water. Tests were conducted to obtain data so that methods can be devised to either reduce or eliminate effects from these problems. Data show that scaling can be prevented, but only by using a high concentration of dispersant. Pitting data, however, are not as conclusive and seem to indicate that pitting control cannot be realized, but this result cannot be substantiated without additional experimentation. Results also demonstrate that chromate can be removed by using either chemical destruction or ion exchange. Whichever method is used, EPA discharge limits for both chromate and zinc can be achieved. A preliminary economic analysis is presented.

17640 (EPRI-WS—79-166, pp 3.1-3.3) **Rotary Separator Turbine Demonstration Program field tests at the East Mesa and Raft River Geothermal Test Facilities.** Hays, L.; Cerini, D.J. (Biphase Energy Systems, Santa Monica, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The rotary separator turbine is being developed by Biphase Energy Systems under the sponsorship of the Electric Power Research Institute. The field test portion of this development program is described. The tests described are that of a prototype rotary separator turbine, RST. The test system was designed to demonstrate operation as a geothermal wellhead conversion system. The geothermal fluid is processed at the wellhead to produce three system outputs: (1) steam for subsequent energy extraction via steam turbine, (2) mechanical output power from the brine-driven liquid turbine, and (3) repressurized brine output as required for brine reinjection. The test results describe the operation of the system at the Department of Energy Geothermal Test Facilities at East Mesa, California, and Raft River, Idaho.

17641 (EPRI-WS—79-166, pp 6.6-6.10) **Two-phase expanders.** Elliott, D.G. (Jet Propulsion Lab., Pasadena, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

Examples are given of two-phase expanders in geothermal power. Recent development work in two-phase expanders is reviewed. Screw expanders, two-phase turbines, two-phase nozzles, two-phase binary cycle, and two-phase turbine rotors are discussed. (MHR)

GEOTHERMAL ENGINEERING

REFER ALSO TO CITATION(S) 17631

DRILLING TECHNOLOGY AND WELL HARDWARE

17642 (SAND—79-7124) **Program for the improvement of downhole drilling-motor bearings and seals. Final report: Phase III, Part 1.** (Terra Tek, Inc., Salt Lake City, UT (USA)). Mar 1980. Contract EY-76-C-04-0789. 201p. Dep. NTIS, PC A10/MF A01.

A systematic laboratory testing and evaluation program to select high-temperature seals, bearings, and lubricants for geothermal downhole drilling motors is summarized.

17643 (SAND—79-7125) **Program for the Improvement of Downhole Drilling-Motor Bearings and Seals. Phase III, Part 2: final report.** (Terra Tek, Inc., Salt Lake City, UT (USA)). Mar 1980. Contract EY-76-C-04-0789. 87p. Dep. NTIS, PC A05/MF A01.

Six months of activity to improve downhole drilling-motor bearings and seals for geothermal applications are reported. The following are covered: seal testing and evaluation, bearing-seal package testing and evaluation, lubricant testing and evaluation, and program status, plans and schedule. (MHR)

17644 (SAND—80-7030) **Bending stress and frequency calculations for the bearing-pack shaft.** Barnwell, J.; Dareing, D.W. (Maurer Engineering, Inc., Houston, TX (USA)). Apr 1980. Contract EY-76-C-04-0789. 33p. Dep. NTIS, PC A03/MF A01.

The bearing-pack shaft investigation was conducted to analyze bending and cycle fatigue stresses and resonance. The bending stresses produced were considered to be minimal, and the cycle fatigue stress was less than the material's endurance level. Resonating frequencies were estimated to be sufficiently high to preclude problems.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 17639

17645 (EPRI-WS—79-166, pp 3.4-3.8) **FLOSCAL: a computer code for predicting scale formation in geothermal systems.** Lessor, D.L.; Kreid, D.K.; Cheatham, R.L. (Battelle Pacific Northwest Labs., Richland, WA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

FLOSCAL is a computer program that may be used to predict the chemical composition, rate of formation, and distribution of mineral scale and iron corrosion products in a mineral laden aqueous flowstream. A description is provided of FLOSCAL capabilities and limitations. (MHR)

17646 (EPRI-WS—79-166, pp 3.9-3.14) **Effect of acid addition for scale control on geothermal field and plant systems.** Reynolds, S.L. (Systems, Science, and Software, La Jolla, CA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

An EPRI effort to move the EQUILIB code into use for analysis of problems in geothermal brine chemistry is described. A number of computer runs were conducted to develop data for a matrix of baseline cases using two brines, two power plant types, and two mineral treatment modes. The results are summarized. (MHR)

17647 (EPRI-WS—79-166, pp 3.15-3.21) **Summary of recent FLOSCAL/EQUILIB simulations of scaling and corrosion in geothermal systems.** Lessor, D.L.; Kreid, D.K.; Cheatham, R.L. (Battelle Pacific Northwest Labs., Richland, WA). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

FLOSCAL/EQUILIB simulations will be performed for all selected cases using prototypic brine data and flow/process specifications. Simulations of power plant performance degradation due to the effects of scale and corrosion will also be performed for some of the cases using the entire family of codes. Results of simulations of the Heber 2000 hr heat exchanger tests, simulation of flashing well tests, and preliminary plans for simulations of the PSEMT are reviewed.

17648 (EPRI-WS—79-166, pp 4.44-4.52) **Evaluation of the scaling incidence in Cerro Prieto.** Mercado, S.; Hurtado, R.; Damian, F. (Institute de Investigaciones Electricas, Cuernavaca, Mexico). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

For the specific case of the highly encrusting Cerro Prieto brines, the separator tests showed that the lowest practical operating pressure is 15 psig. This will be the minimum operating pressure for the 30 MW low separation pressure plant which is due to start operating by 1982. (MHR)

17649 (EPRI-WS—79-166, pp 6.32-6.38) **Status of geothermal brine treatment technology.** Weres, O. (Univ. of California, Berkeley). Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

An overview is given of the practical experience and state of the art in geothermal brine chemistry and brine treatment technology. The emphasis is on defining what sorts of brine treatments may be needed by a typical geothermal electric development project, what is available, and how the developers may expect to proceed in dealing with anticipated brine chemistry related problems.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

17650 (EPRI-WS—79-166, pp 2.1-2.8) **Production behavior and economic assessment of geopressured reservoirs in the Texas and Louisiana Gulf Coast.** Swanson, R.K. (Southwest Research Inst., San Antonio, TX); Osoba, J.S. Oct 1979.

From 3. annual EPRI geothermal conference; Monterey, CA, USA (26 Jun 1979).

The characteristics and extent of geopressured reservoirs are discussed relative to contained and recoverable energy. The following production parameters are described: wellbore diameter, formation permeability, reservoir performance, and formation compressibility. The following economic factors are explored: value of thermal energy, methane value, and calculation of return. (MHR)

GEOTHERMAL DATA AND THEORY

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 17911, 17912

17651 (LBL—7090) **Kinetic equations and type curves for predicting the precipitation of amorphous silica from geothermal brines.** Weres, O.; Yee, A.W.; Tsao, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1978. Contract W-7405-ENG-48. 8p. (CONF-790108—5). Dep. NTIS, PC A02/MF A01.

From 1979 SPE international symposium on oilfield and geothermal chemistry; Houston, TX, USA (22 Jan 1979).

The kinetics of amorphous silica precipitation from aqueous solution up to 100°C and containing up to 1M NaCl were studied experimentally. Empirical equations for the rate of molecular deposition on surfaces as a function of temperature, dissolved silica concentration, pH and salinity are presented. Empirical type curves which depict the decrease in dissolved silica concentration through homogeneous nucleation of colloidal silica are also presented. Two practical examples related to geothermal practice are given.

ROCK-WATER-GAS INTERACTIONS

17652 **Experimental evidence of rare earth element immobility in greenstones.** Menzies, M. (Univ. of Minnesota, Minneapolis); Seyfried, W. Jr.; Blanchard, D. *Nature (London)*; **282**: No. 5737, 398-399(22 Nov 1979).

Significant petrogenetic importance has recently been placed on the Nd isotopic composition and variable rare earth element (REE) content of basalts, although the effect of alteration on the REE has not been fully investigated. REE analyses of oceanic and ophiolitic basalts suggest that the light REE (La, Ce, Nd, Sm, Eu) are mobile during basalt-seawater interaction at relatively low temperatures. However, the behavior of the trace and rare earth elements during greenstone formation at higher temperatures is less well understood, primarily because of uncertainties regarding the composition of the unaltered precursor, temperature, pressure and effective water/rock ratio. In an attempt to overcome these uncertainties basalt glass subjected to 10 individual basalt-seawater interaction experiments was analyzed. In all these experiments the REE are found to be immobile at temperatures of 150 to 350°C, even when the badsalt is totally altered to clay. Furthermore, the data suggest that the minor fluctuations observed in the light REE content of some greenstones may result from a low-temperature overprint due to retrograding of the greenschist facies basalts. 1 figure.

TIDAL POWER

WAVE ENERGY CONVERTERS

17653 (STU—77-7566) **Wave power plant: System Loquist-Gustofsson-Noren.** Fredriksson, G. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Sep 1979. 23p. (In Swedish). Dep. NTIS (US Sales Only), PC A02/MF A01.

A model of a wave plant has been tested. The device consists of a circular buoy, 0.75 m in diameter, equipped with an accelerator - tube 3 to 5 m long. A piston in this tube drives a dc-generator in the buoy. The test results are in good agreement with theoretical calculations. The hydro-mechanical efficiency was rather insensitive to the damping factor and reached a mean of 0.3 to 0.4, with a top valve of 0.68. It is estimated that a 40 to 45 kW wave power plant (2 m waves, buoy diameter 7.5 m) would cost about 0.2 MSKR to build.

WIND ENERGY

17654 (DOE/ET/20468—T1) **Energy from the wind: annotated bibliography. Second supplement.** Burke, B.L. (comp.). (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Dec 1979. Contract ET-78-C-02-4956. 374p. Dep. NTIS, PC A16/MF A01.

The bibliography is organized by year, in entry number order. So that the Second Supplement may be merged with the Basic Volume and First Supplement if desired, entry numbers in the Second Supplement are assigned to follow consecutively those entry numbers used in the first two volumes. Therefore in most years entry numbers do not begin with I, but with a number to immediately follow the last entry number used for that year in the first Supplement.

17655 (SERI/TP—245-184) **Wind Energy Innovative Systems conference proceedings.** Vas, I.E. (ed.). (JBF Scientific Corp., Arlington, VA (USA); Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 369p. (CONF-790501—). Dep. NTIS, PC A16/MF A01.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Separate abstracts are included for 20 of the 22 papers presented concerning innovative wind turbines which vary in design from the standard horizontal-axis propellor-type wind turbines. Two papers have been previously included in the data base.

17656 (SERI/TP—245-184, pp 1-13) **Federal wind energy program: an overview.** Tennyson, G.P. (Dept. of Energy, Washington, DC). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

A review of the US DOE wind energy program is presented.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 17660, 17997

17657 (RLO—2439-78/2) **Interannual and month-to-month variations of wind speed. Technical report.** Justus, C.G.; Mani, K.; Mikhail, A. (Georgia Inst. of Tech., Atlanta (USA)). Apr 1978. Contract EY-76-S-06-2439. 101p. Dep. NTIS, PC A06/MF A01.

Spatial cross-correlations and interannual and month-to-month variation of monthly and annual mean wind speed were studies at 40 sites throughout the United States. Sites were selected on the basis of availability of 10 or more years of data from a fixed anemometer location and height and climatic mean speed of 5 m/s (11 mph) or higher. Spatial cross-correlation of monthly deviations from climatic means was found to be about 0.5 for sites separated by

less than 200 km, with annual mean wind deviations from climatic mean correlated with coefficient value 0.32 for similarly separated sites.

17658 (SERI/TP—245-184, pp 15-24) **Overview of the wind characteristics program.** Wendell, L.L. (Pacific Northwest Lab., Richland, WA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Within the Federal Wind Energy Program, the Wind Characteristics Program Element (WCPE) has been established to assemble and develop wind characteristics information for those involved in (1) designing and evaluating the performance of wind energy conversion systems (WECS), (2) planning energy programs, (3) selecting sites for installing WECS, and (4) operating WECS. The technical portion of the WCPE has been divided into four program areas to expedite the accomplishment of these tasks. Research plans and overall progress to date are presented with emphasis on the Resource Assessment Program area.

17659 (UUIM—55) **Statistical analysis of wind, wind profiles and gust ratios at Graenby, Uppsala.** Alexandersson, H. (Uppsala Univ. (Sweden). Meteorologiska Institutionen). 1979. 73p. Dep. NTIS (US Sales Only), PC A04/MF A01.

A statistical analysis of wind data from Uppsala, Sweden is presented. Measurements are obtained from a 100 m meteorological tower at Graenby situated at the NE boundary-line of the city. The data from the profile instrumentation (8 levels) are exploited. The collection of data is primarily divided into 5 x 8 classes with respect to stability and wind direction and some mean profiles are presented and discussed. The Weibull distribution and the corresponding asymptotic extreme value distribution have been used to describe the observed frequencies and extend the results. The important extension to short averaging times is briefly analysed and discussed.

ECONOMICS

REFER ALSO TO CITATION(S) 17667, 17669, 17670, 17671, 17673, 17674

17660 (COO—2992-78/1-T1) **Application study of wind power technology to the city of Hart, Michigan, 1977. Executive summary.** Krauss, O.; Park, G.L.; Linvill, D.E. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Aug 1978. Contract EY-76-S-02-2992. 14p. Dep. NTIS, PC A02/MF A01.

Several generation-expansion alternatives for small electric utilities which include windpower were evaluated using the municipal electric syystem of Hart, Michigan, as an example. Assumed wind turbine configurations with machines rated at 500-kW and 1500-kW together with a 1000-kW hydroelectric facility were combined with conventional Hart diesel generation plus bulk purchase and then evaluated. For comparison, a new 3600-kW oil-fueled diesel generator was also evaluated. Wind data from US Coast Guard stations in the Hart vicinity was processed and verified by means of a 2-year measurement program.

17661 (SERI/TP—245-184, pp 25-39) **Energy technology and commercialization issues.** Parthe, A.C. Jr. (Charles Stark Draper Lab., Cambridge, MA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Market demand, price, infrastructure requirements, legal-social-environmental issues, and competing technologies are being studied and assessed with respect to utilizing government incentives and subsidies to accelerate commercialization. Technical issues form one part of the requirements. The current DOE Wind Energy program is reviewed and the above issues are analyzed in relationship to it. References are made to previous government sponsored development and demonstration projects; where appropriate, analogies and experience are related to the Wind Energy Program. Commercialization requirements, as viewed by the supply and market sectors, are emphasized.

17662 (SERI/TP—245-184, pp 153-170) **Preliminary technical and economic evaluation of vortex extraction devices.** Kornreich, T.R.; Kottler, R.J. Jr.; Jennings, D.M. (JBF Scientific Corp., Arlington, VA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Two innovative vortex extraction devices -- the Tornado Wind Energy System (TWES) and the Vortex Augmentor Concept (VAC) -- are critically evaluated to provide a preliminary assessment of their technical and economic viability compared to conventional horizontal axis wind energy systems. There are many technical uncertainties which still need to be resolved before the technical feasibility of the TWES can be assured. Present experimental work has dealt with very small-scale wind tunnel tests so that available data cannot be used with any degree of confidence to resolve these uncertainties and estimate full-scale system performance.

WIND ENERGY ENGINEERING

APPLICATIONS

REFER ALSO TO CITATION(S) 17810

TURBINE DESIGN AND OPERATION

17663 (DOE/NASA/1028—80/26) **Teetered, tip-controlled rotor: preliminary test results from MOD-0 100-kW experimental wind turbine.** Glasgow, J.C.; Miller, D.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract EX-76-I-01-1028. 16p. (NASA-TM—81445; CONF-800406—4). Dep. NTIS, PC A02/MF A01.

From Wind energy conference; Boulder, CO, USA (9 Apr 1980).

A series of tests is currently being conducted using the DOE/NASA 100 kW Experimental Wind Turbine with a two-bladed, teetered rotor with 30% span tip control. Preliminary evaluation test results indicate that the teetered rotor significantly decreases loads on the yaw drive mechanism and reduces blade cyclic flapwise bending moments by 25% at the 20% span location when compared to rigid hub rotor. The teetered hub performed well but did impact the teeter stops on occasion as wind speed and/or direction varied rapidly. The tip-controlled rotor performed satisfactorily with some expected loss of control when compared to the full span pitchable blade. The performance results indicate that a review of techniques used to calculate rotor power is in order.

17664 (SERI/TP—245-184, pp 41-55) **Rocky flats small wind systems program overview.** Healy, T.J. (Rockwell International, Golden, CO). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

An overview is presented of the Rocky Flats Small Wind Systems Program sponsored by the United States Department of Energy (DOE). This program provides technical and management support for the development of small wind systems. The overall objective is to stimulate the manufacture of small wind energy conversion systems (SWECS) by the private sector and utilization of these systems by the public. The informaion provided describes the current program in terms of its objectives, activity highlights and futre plans for FY1979 as well as projections through 1981.

17665 (SERI/TP—245-184, pp 71-87) **Utility-sized wind-powered electric plants based on the Madaras rotor concept.** Whitford, D.H.; Minardi, J.E. (Univ. of Dayton Research Inst., OH). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The Madaras Rotor Power Plant concept was analyzed and updated to determine its capability to compete technically and economically with conventional horizontal axis wind turbines (HAWTG). This concept, developed in the 1930's, utilizes rotating cylinders, vertically mounted on flat cars, to react with the wind (Magnus effect) and propel an endless train of cars around a closed track at constant speed. Alternators geared to the wheels of each car generated electrical power, which was transmitted to a power station by a trolley system. The study consisted of a wind tunnel test series, an electromechanical design, a performance analysis, and a cost analysis.

17666 (SERI/TP—245-184, pp 121-134) **Technical development of the diffuser augmented wind turbine (DAWT) concept.** Foreman, K.M.; Gilbert, B.L. (Grumman Aerospace Corp., Bethpage, NY). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

As a result of a three-year, multi-phased investigation, using three test facilities and a multi-bladed turbine as well as simulated turbines (i.e., screens), several compact diffuser designs have been developed that appear technically and economically attractive. These model tests already demonstrate a relative power coefficient (augmentation) that is over 350% better than an ideal conventional turbine of the same diameter and at the same free wind speed. These test results also point the direction to further DAWT system refinements expected to yield augmentation factors of 6 to 8 times conventional turbines. In addition, because DAWT's inherently have better plant capacity factors compared to conventional bare turbines, the busbar cost of generated electricity potentially can be brought to cost-competitive levels.

17667 (SERI/TP—245-184, pp 137-151) **Recent developments of the tornado-type wind energy system.** Yen, J.T.; DeCarlo, J.; Zywan, W. (Grumman Aerospace Corp., Bethpage, NY). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Recent developments in Tornado-type Wind Energy System are presented including the findings that the vanes of the vortex collecting tower can be permanently fixed and opened to winds from all directions; data measured from small models with fixed-vanes give a current level of performance of around 0.10 for the power coefficient based on the tower frontal area; fixed-vane tower design yields major reductions in tower costs and significant reductions in capital costs against some degradation in performance due to some leakage of wind energy from the fixed-vanes; employing a reasonable system cost of $100/m^2$ ($10/ft^2$) of tower surface area shows that at mass production of full-scale units, the Tornado-type wind energy system would yield a capital cost of $300 to 500/kW installed and an energy cost of 2 to 4 cents/kWh.

17668 (SERI/TP—245-184, pp 171-184) **Field testing the vortex augmentor concept.** Sforza, P.M.; Stasi, W.J. (Polytechnic Inst. of New York Aerodynamics Labs., Farmingdale). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The field test of a large-scale VAC model is described. the details of a wind data network, the prototype instrumentation, the data acquisition and processing system, the results of the field tests of system performance, the comparisons to theoretical predictions, and a discussion of the problems associated with field testing as well as recommendations for further research based upon the experience gained in the present program are presented.

17669 (SERI/TP—245-184, pp 185-199) **Augmented horizontal axis wind energy systems assessment.** Harper, M.R. (Tetra Tech, Inc., Arlington, VA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Aerodynamic devices that augment natural winds of low kinetic energy density have the potential for providing a cost-effective energy resource system. Several concepts are discussed in which an augmentor surface is used to increase the mass flow through a turbine, increasing the turbine's power output. Three concepts are assessed. The first is the diffuser augmented wind turbine, in which a diffuser is used to produce a pressure considerably below atmospheric behind the rotor to induce increased flow through the rotor. The second is the vortex augmentor concept, in which the augmentor surface is a highly swept delta wing. This surface creates vortices that concentrate kinetic energy; two turbines are then placed in the vortices to extract this energy. The third concept is the dynamic inducer, in which end plates on a conventional turbine are used to induce increased flow through the rotor.

17670 (SERI/TP—245-184, pp 201-216) **Definitive generic study of augmented horizontal axis wind energy systems.** Lissaman, P.B.S.; Hibbs, B.; Walker, S.N.; Zambrano, T.G. (AeroVironment Inc., Pasadena, CA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Two fundamental types of augmentors were considered: dynamic, and passive. The passive designs included both an axisymmetric duct (shroud ring) surrounding the actuator disk, and also a planar delta wing in the vicinity of the actuator disk. The dynamic design involves attaching airfoil tipvanes to the rotor blades themselves. Aerodynamic performance of all of the systems were computed and then were sized to produce the same power output as the NASA Mod-X wind turbine. Estimates of the cost of each resulting augmented system was performed; the cost of power was then calculated and compared to the Mod-X. For all augmented designs, the power costs varied between 1.2 and 3.0 times those of the baseline Mod-X. Thus, all of the augmented systems appear less cost-effective than the Mod-X.

17671 (SERI/TP—245-184, pp 219-228) **Large horizontal-axis wind turbine development.** Robbins, W.H.; Thomas, R.L. (NASA Lewis Research Center, Cleveland, OH). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

One facet of the Federal Wind Energy Program, Large Horizontal Axis Wind Turbine Development, is being managed by the NASA Lewis Research Center. These activities consist of several ongoing wind system developments oriented primarily toward utility application. In addition, a comprehensive technology program supporting the wind turbine projects is being conducted. An overview of the NASA activities is presented.

17672 (SERI/TP—245-184, pp 231-243) **Innovative straight bladed vertical axis wind turbine.** Walters, R.E.; Migliore, P.G.; Wolfe, W.P. (West Virginia Univ., Morgantown). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Those theoretical and experimental studies of straight bladed Darrieus wind turbines which have been conducted at West Virginia University (WVU) since 1975 are reviewed. Emphasis is placed on the unusual aerodynamic effects which result from the orbital motion of the turbine blades, and the significance of these effects regarding turbine blade design is discussed. Blade test data from an outdoor turbine are compared to two dimensional wind tunnel tests of the same blades, and substantial differences in blade drag are noted. These differences are explained in terms of flow curvature, and the analytical techniques for investigation of this phenomenon are briefly mentioned.

17673 (SERI/TP—245-184, pp 245-264) **Augmented vertical axis wind energy system evaluation.** Hoffert, M.I.; Miller, G. (New York Univ., New York). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Performance and cost characteristics of wind energy conversion systems employing both a vertical axis of rotation and some form of augmentation beyond a stand-along rotor are assessed, with emphasis on two systems currently approaching commercial feasibility: (1) the Tornado-Vortex Yen Wind Turbine (YWT) and (2) the diffusor-augmented Lebost Wind Turbine (LWT). Both technological and cost-effectiveness considerations are discussed for these systems with emphasis on developing appropriate economic measures for their respective applications, i.e. electric power generation for the YWT and residential and commercial space heating for the LWT. A cost-effectiveness analysis is developed for target costs per unit frontal area for such systems showing the influence of annual mean windspeed, tower height, atmospheric boundary layer stability, capital-cost financing rates and the inflation rate of the fossil fuel displaced.

17674 (SERI/TP—245-184, pp 283-298) **Sailwing wind energy systems assessment.** Hohenemser, K.H. (Washington Univ., Technology Associates., St. Louis, MO). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The sailwing windmill was conceived by T.E. Sweeney at Princeton University. Performance measurements were made with sailwing wind rotor models on a moving test bed. A 7.6 meter (25 ft.) diameter machine was built by Grumman Energy Systems and is presently turning essentially without power extraction at a site administered by Princeton University. It is estimated that the cost of energy from this windmill is comparable to that of good conventional wind machines of its size, namely 0.09 to 0.12 $/KWh for low quantity production and 0.06 to 0.07 $/KWh for advanced versions in high quantity production. The sailwind rotor has four times the blade area of a conventional windmill with fiberglass blades without an increase in blade weight or blade cost.

17675 (SERI/TP—245-184, pp 301-312) **Definitive generic study for the effect of high lift airfoils on wind turbine cost effectiveness.** Lissaman, P.B.S.; Wilson, R.E.; Thresher, R.W.; Walker, S.N. (AeroVironment, Inc., Pasadena, CA). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The effect of high lift devices on the system cost-effectiveness of wind turbines was studied for the case of both horizontal axis and vertical axis machines. A comprehensive review of the various types of high lift airfoil sections was performed with respect to generalized aerodynamic performance and structural considerations. Airfoils having promise included high lift incipient separation sections, symmetrical high lift air foils, and extra thick designs. Jet flaps and multi-element sections were determined to be too complicated for practical applications. The performances of both horizontal axis (NASA MOD-X) and vertical axis (Sandia Lab Darrieus) wind turbines were modeled for baseline cases, assuming units rated at 200 kW, for a variety of different rotor airfoil sections and planforms.

17676 (SERI/TP—245-184, pp 335-343) **Summary of the wind energy innovative systems program.** Vas, I.E. (Solar Energy Research Inst., Golden, CO). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The objective of this program is to determine the technical and economic feasibility of potentially cost competitive innovative systems. Studies performed in this program are subcontracted to small and large private companies as well as to universities. At present, 14 studies are funded. Eight of these are R and D studies which address various types of augmentation and electrofluid dynamic type sysems. Six of the studies are short-term, assessing the value of innovative systems by generic order. Technical papers on the innovative concepts and assessments of these concepts have been presented by the principal investigators. Highlights of these concepts are indicated.

POWER CONVERSION SYSTEMS

17677 (DSE—2322-T2) **System dynamics of multi-unit wind energy conversion systems application. Final report.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). Feb 1978. Contract EX-76-C-01-2332. 399p. Dep. NTIS, PC A17/MF A01.

The purpose of the study is to provide design information for the WECS machine and for the electrical utility power system interface which would allow a significant number of WECS to be incorporated into the power system. The basic ingredients of the study are wind characteristics, WTG machine characteristics, protection and control for both the WECS and the utility and representative power system characteristics. A specific goal is to determine the feasibility and constraints of installing numerous WECS either in a group or scattered throughout the power system.

17678 (SERI/TP—245-184, pp 89-100) **Electrofluid (EFD) wind driven generator.** Minardi, J.E.; Lawson, M.O. (Univ. of Dayton Research Inst., OH). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

The Electrofluid Dynamic (EFD) wind driven generator directly converts wind energy to electrical energy without moving parts. Conventional wind turbines are currently limited in size, with the greatest diameter presently envisaged being 300 to 400 feet. For the EFD wind driven generator there are no fundamental reasons to restrict the size; therefore, economics of scale and far larger than from conventional systems can be realized. Analyses predict favorable performance characteristics for EFD wind generators; however, specific experimental data have been lacking. Research areas presently being emphasized are discussed and performance of experimental arrays under test in an Eiffel-type wind tunnel are also discussed.

17679 (SERI/TP—245-184, pp 103-117) **Wind/electric power transduction using charged aerosols under various atmospheric conditions.** Marks, A.M. (Marks Polarized Corp., Whitestone, NY). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

Experimental data is presented on two methods of producing a charged aerosol under atmospheric conditions. A first charging method utilizes a water jet in an electric field, issuing from a small orifice and impacted by an air jet issuing from another small orifice. A second preferred charging method utilizes a water jet only in an electric field. A charged aerosol was produced in a wind tunnel using the first method and measurements were taken. The electric efficiency was 75 to 97% with atmospheric relative humidities of 25 to 95% and air temperatures of 20 to 40°C, at wind speeds of 2.5 to 15 m/s. These results demonstrate the feasibility of the transduction of wind power to electric power using a charged aerosol.

17680 (SERI/TP—245-184, pp 267-281) **Energy from humid air.** Oliver, T.K.; Groves, W.N.; Gruber, C.L.; Cheung, A. (South Dakota School of Mines and Tech., Rapid City). Dec 1979.

From Wind energy innovative systems conference; Colorado Springs, CO, USA (23 May 1979).

This is a summary of results to date of a research project which is in progress at the South Dakota School of Mines and Technology. The goal of the research is to find a cost-effective process to convert the energy in humid air into mechanical work, which will be used to drive an electrical generator. The research is being carried out by computer modeling. Results for a natural draft tower show that it is not a cost-effective way to get energy from humid air. Parametric studies are presented for expansion-compression cycles. With suitable conditions, including large amounts of cooling during compression, this cycle has an attractive net work output. To avoid using all the output power to overcome machine losses, it appears necessary to use a one-machine mechanization.

ELECTRIC POWER ENGINEERING

17681 (DOE/TIC—11145) **Bibliography techniques for analyzing the impacts of certain electric utility concepts. Volume 6.** (Stone and Webster Management Consultants, Inc., New York (USA)). Mar 1980. Contract EC-77-C-01-2097. 407p. Dep. NTIS, PC A18/MF A01.

This extensive bibliography provides documentation to assist state public utility commissions and major nonregulated utilities in evaluating the applicability of a wide range of electric utility rate design ad regulatory concepts in light of certain regulatory objectives. Subjects covered in Part I, Utility Regulatory Objectives, are conservation of energy and capital, efficient use of facilities and resources, and equitable rates to electricity consumers. Part II, Rate Design Concepts, considers time-of-day rates; seasonally-varying rates; cost-of-service (customer-energy-demand charge) rates; interruptible rates, including the accompanying use of load management techniques; declining block rates; and lifeline rates. Part III, Regulatory Concepts, covers the following: restrictions on master metering; procedures for review of automatic adjustment clauses; prohibitions of rate or regulatory discrimination against solar, wind, or other small energy systems; procedures to provide adequate information to consumers; treatment of advertising expenses; procedures to protect ratepayers from abrupt termination of service.

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 17960

17682 **Regional trends in power plant siting.** Cirillo, R.R.; Wolsko, T.D.; Mueller, R.O. (Argonne National Lab., IL). pp 138-143 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses problems related to power plant site selection procedure. Site selection is part of overall system planning that includes load forecasting, generator selection, reliability analyses, territorial considerations corporate policy, and economics. Regional perspectives reinforce the conclusion that air quality is an important constraint in power plant siting.

17683 **Assessing regional impacts of advanced energy systems.** Brumberg, R. (Gilbert Associates, Inc., Reading, PA). pp 374-379 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The purpose of this paper is to examine the potential market penetration impacts of several developing electric energy systems in the context of regional applications. The solar electric and high efficiency fossil electric systems could make modest contributions to national energy supply.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 17680, 18011

17684 (ORNL/TM—6254) **Summary of research and development effort on air and water cooling of gas turbine blades.** Fraas, A.P. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 52p. Dep. NTIS, PC A04/MF A01.

The review on air- and water-cooled gas turbines from the 1904 Lemale-Armengaud water-cooled gas turbine, the 1948 to 1952 NACA work, and the program at GE indicates that the potential of air cooling has been largely exploited in reaching temperatures of 1100°C (~ 2000°F) in utility service and that further increases in turbine inlet temperature may be obtained with water cooling. The local heat flux in the first-stage turbine rotor with water cooling is very high, yielding high-temperature gradients and severe thermal stresses. Analyses and tests indicate that by employing a blade with an outer cladding of an ~ 1-mm-thick oxidation-resistant high-nickel alloy, a sublayer of a high-thermal-conductivity, high-strength, copper alloy containing closely spaced cooling passages ~ 2 mm in ID to minimize thermal gradients, and a central high-strength alloy structural spar, it appears possible to operate a water-cooled gas turbine with an inlet gas temperature of 1370°C. The cooling-water passages must be lined with an iron-chrome-nickel alloy must be bent 90° to extend in a neatly spaced array through the platform at the base of the blade. The complex geometry of the blade design presents truly formidable fabrication problems. The water flow rate to each of many thousands of coolant passages must be metered and held to within rather close limits because the heat flux is so high that a local flow interruption of only a few seconds would lead to a serious failure.Heat losses to the cooling water will run ~ 10% of the heat from the fuel. By recoverying this waste heat for feedwater heating in a command cycle, these heat losses will give a degradation in the power plant output of ~ 5% relative to what might be obtained if no cooling were required. However, the associated power loss is less than half that to be expected with an elegant air cooling system.

POWER CYCLES

REFER ALSO TO CITATION(S) 17785

COMPONENTS

REFER ALSO TO CITATION(S) 17684

17685 (CONF-790167—(Vol.2), pp 41p, Paper 13) **Marshall Steam Station Unit 4 ID fan problem.** Barrow, W.E. (Duke Power Co., Charlotte, NC). Aug 1979.

From Workshop on power plant availability engineering and productivity improvement; Los Angeles, CA, USA (9 Jan 1979).

Problems with the erosion and cracking of fan blades in the induced draft system of the coal-fired Marshall Power Plant, the effect of these problems on plant availability, and the actions taken to remedy the problems are discussed. The installation of added electrostatic precipitators to achieve a precipitator efficiency of 99.7% is also mentioned. (LCL)

WASTE HEAT UTILIZATION

17686 (ORNL/TM—7167) **Browns Ferry waste heat greenhouse environmental control system design.** Olszewski, M.; Stovall, T.K.; Hicks, N.G.; Pile, R.S.; Burns, E.R.; Waddell, E.L. Jr. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 27p. Dep. NTIS, PC A03/MF A01.

Oak Ridge National Laboratory, Tennessee Valley Authority and the Environmental Research Laboratory at the University of Arizona cooperated on the design of an experimental greenhouse located at TVA's Browns Ferry Nuclear Generating Station. Two greenhouse zones are heated by waste heat from the plant's condenser effluent. For comparison, a third greenhouse zone is heated conventionally (fossil-fueled burners) as a control. Design specifics for each of the three zones and a qualitative operating evaluation are presented.

ECONOMICS

REFER ALSO TO CITATION(S) 17682

17687 (NUREG—0607) **Treatment of inflation in the development of discount rates and levelized costs in NEPA analyses for the electric utility industry.** Roberts, J.O.; Davis, S.M.; Feld, S.E.; Nash, D.A.; Abramson, L.R. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jan 1980. 25p. NTIS.

The report discusses discount rate, present value, escalation, and levelized cost. The objective is to establish a relation between inflation and the cost of money (i.e., discount rate). This will provide a means of maintaining consistency between discount rates and various assumed inflation rates and assurance that cost benefit analysis results are not biased because of inconsistent assumptions concerning inflation and discount rates (assuming that for NEPA analysis for the utility industry the discount rate is synonymous with the cost of money to the utility industry). The relation between the cost of money with and without inflation and the rationale for a discount rate that may be used in cost-benefit analyses relating to the production of electricity is presented. Also, two methods for levelizing present value cost (i.e., in nominal and constant dollars) are discussed. The discount rate, the relation between the discount rate and inflation, and the levelizing methods discussed in this document will be used in many NRC studies involving cost benefit analysis.

FUELS

REFER ALSO TO CITATION(S) 17784

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 18013, 18031, 18058, 18081

17688 **Powdered coal-in-oil mixtures: results of the General Motors Consortial Program.** Brown, A. Jr. (General Motors Corp., Warren, MI). pp 43-47 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The paper discusses the substitution of pulverized coal-in-oil for coal. The potential benefits to the US of using coal-oil mixtures are: (1) extension of fuel supplies for transportation, chemical and home use; (2) expanded use of coal; (3) minimal capital expenditure; (4) operating cost savings; and (5) versatility of operation.

17689 **Impact on ambient air quality of converting power stations and industrial boilers to coal combustion.** Denham, R.S. (NUS Corp., Rockville, MD). pp 180-185 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The coal conversion program has started slowly, and there are significant restraints which will limit its rate of implementation. These include the effect of air pollution regulations on individual plants, the availability of coal supplies with appropriate sulfur content, the availability of air pollution control equipment necessary to meet regulatory requirements, and the complex nature of the program itself, requiring independent sequential evaluations of mechanical feasibility, fuel availability, environmental compatibility, and economic practicality, before notices of effectiveness can be issued to prohibition and construction orders. These factors provide assurance that the impact of this program on ambient air quality will be minimal for some years to come, and in fact, except in localized cases, no real effect directly attributable to the coal conversion program may ever be measured in the ambient air.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 18011

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 17363, 17682, 17685, 17961, 17962, 17963, 17964, 17965, 17966, 17967, 18000

17690 **Assessment of trace element body burdens due to projected coal utilization in the Illinois River Basin.** Gasper, J.R.; Dauzvardis, P.A. (Argonne National Lab., IL). pp 350-354 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Results of an assessment of the increased future use of coal in the Illinois River Basin indicate that the release of certain trace elements during combustion may contribute to the violation of suggested air and water quality criteria when background concentrations of these elements are considered. In addition, these releases into the environment may lead to the doubling of trace element body burdens that exist from current background exposures. However, these incremental increases in body burden will be several orders of magnitude less than current estimated body burdens due solely to dietary intake of trace elements.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 17533

17691 (COO—4305-1) **Control of the power system in the normal state. Final report.** Zaborszky, J.; Mukai, H.; Singh, J.; Spare, J.H. (Washington Univ., St. Louis, MO (USA). Dept. of Systems Science and Mathematics; Philadelphia Electric Co., PA (USA)). 31 Aug 1979. Contract EC-77-S-02-4305. 47p. Dep. NTIS, PC A03/MF A01.

The economic dispatch and load frequency control problem is approached from scratch as a design for digital computer control with system theoretic foundations, but the ingenious insights gained in the past 30 years of practice are utilized. In Part I, an estimation process is proposed which gives a much tighter estimate of the Area Load Excess (ALE) over the scheduled load than the tranditional Area Control Error (ACE), while it also provides an extrapolated estimate into the future as well as an estimate of the turbine power at each unit. The latter is needed for unit control. Part II introduces a three stage algorithm to generate extrapolated target curves for the individual units to follow for economically matching the area load demand throughout the day. The three stages of the algorithm involve successively shrinking time horizons (one day, one half hour, and one half minute) along with detailed knowledge of the actual load variations and progressively more detailed descriptions of the system. Each algorithmic stage draws on the results of the preceding stage and retains those features of the results which depend on the longer horizon of the preceding stage. The Part 2 algorithm leans, for load data, on the estimation process presented in Part I. The final output is target curves reaching about 1/2 minute into the future, which will be tracked by the power plant controls. This tracking will be discussed in a forthcoming Part III. If the estimation were exact and the unit control instantaneous, the resulting dispatch would be of precisely minimum cost and would be always on schedule in frequency and tie line load. In terms of actual fi'ter and control dynamics this solution will be effective and indeed optimal.

The algorithm can readily incorporate such features as control of inadvertent exchange and jointly owned units, but this incorporation is not discussed.

17692 (DOE/RG/6674—T1) **Investigation into outages of electric power supply as the result of ice storms.** (Commonwealth Associates, Inc., Jackson, MI (USA)). Sep 1979. Contract EB-78-C-01-6674. 69p. Dep. NTIS, PC A04/MF A01.

The accumulation of large amounts of ice on electric power distribution conductors and on trees surrounding these conductors has resulted in a number of extended customer electric power outages. Commonwealth Associates, Inc. was assigned the task of reviewing six ice-caused electric outages at the following utilities: Long Island Lighting Company; Portland General Electric; Central Illinois Public Service; Central Illinois Light Company; Dallas River Power and Light; and City Water, Light and Power Department of Springfield, Illinois. Weather conditions that result in ice storms are reviewed. Discussions conducted with public officials in the affected communities and states are described and results and recommendations are presented.

AC SYSTEMS, EHV AND UHV

17693 (DOE/ET/5916—1) **Model for the ready definition and approximate comparison of alternative high voltage transmission systems.** (Commonwealth Associates, Inc., Jackson, MI (USA)). Dec 1978. Contract ET-78-C-05-5916. 183p. Dep. NTIS, PC A09/MF A01.

A model of generic overhead transmission systems in the range of 362 to 1200 kV ac, and +-400 to +-800 kV dc is developed. Such generic systems are to include (a) transmission from generation to load, and (b) interconnection of two large integrated systems, with and without the existence of an underlying, lower voltage network in either case. The model provides a means whereby an engineer with some experience in power systems planning can make a reconnaissance study of alternatives within a relatively short span of time and with fair accuracy. Given an amount of power to be transferred over a specified distance, the model can be used: to define the workable alternatives in terms of voltages, number of lines, series compensation, and certain other factors affecting transfer capability; to delineate other salient features of the selected alternatives, notably shunt compensation requirements; and to compare the alternatives in terms of potentially relevant benefits and costs. The significant properties of the model, the basis and assumptions necessary to its formulation, instructions for its use, and inherent limitations upon the accuracy to be expected are described.

DC SYSTEMS

REFER ALSO TO CITATION(S) 17693

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 17771

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 17742, 17747, 17748, 17749

17694 (COO—4066-13) **Fuel performance improvement program. Quarterly/annual progress report, October 1978-September 1979.** Crouthamel, C.E. (comp.). (Exxon Nuclear Co., Inc., Richland, WA (USA)). Oct 1979. Contract EY-76-C-02-4046;EY-76-C-06-1830. 175p. (PNL—3218). Dep. NTIS, PC A08/MF A01.

The objective of the Fuel Performance Improvement Program is to develop, test, and demonstrate basically two advanced fuel designs with the capability for improved power ramping performance and thus increase the capability of achieving extended burnup levels to better utilize uranium resources. The irradiations are being supported by out-of-reactor experiments to evaluate the effect of graphite coatings to inhibit stress-corrosion-cracking type cladding failures that are related to pellet-cladding interaction. Instrumented test irradiations in the Halden Boiling Water Reactor (HBWR) have achieved peak burnups of 697 GJ/kgM (8.1 MWd/kgM) with reference, annular-coated-pressurized, and sphere-pac rods.

17695 (DOE/NE—0030/1(80)) **US central station nuclear electric generating units: significant milestones. (Status as of January 1, 1980).** (Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy). Mar 1980. 39p. Dep. NTIS, PC A03/MF A01.

Design parameters and licensing data are presented for US nuclear power plants.

17696 (NUREG/CR—1139) **Evaluation of the in-pile pressure data from instrumented fuel assemblies IFA-431 and IFA-432.** Bradley, E.R.; Cunningham, M.E.; Lanning, D.D.; Williford, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 68p. (PNL—3206). Dep. NTIS, PC A04/MF A01.

This report includes results of the examination of the in-pile pressure data from instrumented test assemblies IFA-431 and 432. The pressure data have been used to estimate the fission gas release fraction as a function of fuel burnup. Included are comparisons of the estimated release functions and those predicted by three fission gas release models using the experimental temperature histories of the fuel rods. These comparisons show that fuel temperature is the primary factor in determining fission gas release and that burnup-enhanced fission gas release is not important in UO_2 fuels irradiated to 1700 GJ/kgU (20,000 MWd/MTM).

17697 (PNL-SA—7535) **Impact of decontamination on LWR radioactive waste treatment systems.** Hoenes, G.R.; Perrigo, L.D.; Divine, J.R.; Faust, L.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 34p. (CONF-790923—10). Dep. NTIS, PC A03/MF A01.

From Decontamination and decommissioning of nuclear facilities conference; Sun Valley, ID, USA (16 Sep 1979).

Only at N-Reactor is there a means to accommodate radwaste produced during decontamination. The Dresden system is expected to be ready to accommodate such solutions by the summer of 1979. Solidification of the processed decontamination waste may be a significant problem. There is doubt that the materials in current radwaste treatment systems can handle chemicals from a concentrated process. The total storage volume, for concentrated decontamination, is not sufficient in existing radwaste treatment systems. Greater attention should be placed on designing reactors and radwaste treatment systems for decontamination. A means of handling waste material resulting from leaks in the primary system during the decontamination must be developed. On-site storage of solidified decontamination wastes may be a viable option, but license amendments will be necessary.

17698 **Helium fill gas absorption in pressurized UO_2 fuel rods during irradiation.** Vinjamuri, K.; Owen, D.E. (EG and G Idaho, Inc., Idaho Fall). *Nucl. Technol.;* **47**: No. 1, 119-124(Jan 1980).

Instrumented Fuel Assembly 429, an experimental assembly designed to study helium fill gas absorption and fission gas release in pressurized uranium dioxide (UO_2) fuel rods used in light water reactors, is operating in the Halden Heavy Boiling Water Reactor in Halden, Norway. Preliminary assessment of results from fuel rod internal pressure measurements and from the postirradiation examination of selected fuel rods indicates that helium fill gas is absorbed into the UO_2 during the first several months of operation. The fuel absorbs $\sim 5.7 \times 10^{-3}$ cm^3 He(STP)/g UO_2 at the irradiation conditions of a 5.4-MPa helium pressure and a peak steady-state fuel temperature of 1500 K. The estimated effective helium diffusion coefficient is $\sim 1 \times 10^{-8}$ cm^2/s. Periodic transients with power increases of up to 50% do not drive the helium from the UO_2 matrix.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 17686, 17695, 17696, 17697, 17698, 17739, 17740, 17742, 17744, 17746, 17747, 17748, 17754

17699 (COO—4711-20) **Nondestructive examination of Oconee 1 fuel assemblies after three cycles of irradiation.** Pyecha, T.D.; Davis, H.H.; Mayer, J.T.; Guthrie, B.A. III; Larson, J.G. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.; Duke Power Co., Charlotte, NC (USA)). Sep 1979. Contract ET-78-C-02-4711. 85p. (BAW—1553). Dep. NTIS, PC A05/MF A01.

The Babcock & Wilcox Company (B & W) in conjunction with Duke Power Company is participating in a Department of Energy sponsored research and development program to qualify current design pressurized water reactor (PWR) fuel assemblies for extended burnup (>40,000 MWd/mU). The information obtained from this program will provide a basis for future design improvements in PWR fuel assemblies culminating in an extended burnup assembly having a nominal operating limit of approximately 50,000 MWd/mtU. An extension of the current assembly design to higher burnups will result in the following benefits: (1) lower uranium ore requirements, (2) greater fuel cycle efficiency, (3) reduction in spent

fuel storage requirements, and (4) increased flexibility in tailoring fuel batch sizes to better accommodate the varying energy requirements of the utilities.

17700 (NUREG/CR—1372) **Eddy-current inspection for steam generator tubing program. Quarterly progress report for period ending September 30, 1979.** Dodd, C.V.; Deeds, W.E.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 10p. (ORNL/NUREG/TM—377). Dep. NTIS, PC A02/MF A01.

Eddy-current methods provide the best in-service inspection of steam generator tubing, but present techniques can produce ambiguity because of the many independent variables that affect the signals. The current development program has used mathematical models and developed or modified computer program to design optimum probes, instrumentation, and techniques for multifrequency, multiproperty examinations. Interactive calculations and experimental measurements have been made with the use of modular eddy-current instrumentation and a minicomputer.

17701 (WAPD-TM—1310) **Three core concepts for producing uranium-233 in commercial pressurized light water reactors for possible use in water-cooled breeder reactors.** Conley, G.H.; Cowell, G.K.; Detrick, C.A.; Kusenko, J.; Johnson, E.G.; Dunyak, J.; Flanery, B.K.; Shinko, M.S.; Giffen, R.H.; Rampolla, D.S. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Dec 1979. Contract EY-76-C-11-0014. 318p. Dep. NTIS, PC A14/MF A01.

Selected prebreeder core concepts are described which could be backfit into a reference light water reactor similar to current commercial reactors, and produce uranium-233 for use in water-cooled breeder reactors. The prebreeder concepts were selected on the basis of minimizing fuel system development and reactor changes required to permit a backfit. The fuel assemblies for the prebreeder core concepts discussed would occupy the same space envelope as those in the reference core but contain a 19 by 19 array of fuel rods instead of the reference 17 by 17 array. An instrument well and 28 guide tubes for control rods have been allocated to each prebreeder fuel assembly in a pattern similar to that for the reference fuel assemblies. Backfit of these prebreeder concepts into the reference reactor would require changes only to the upper core support structure while providing flexibility for alternatives in the type of fuel used.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 17718, 17738, 17743

17702 (GA-A—14812(Vol.1)) **Core seismic methods verification report.** Olsen, B.E.; Shatoff, H.D.; Rakowski, J.E.; Rickard, N.D.; Thompson, R.W.; Tow, D.; Lee, T.H. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76ET35300. 379p. Dep. NTIS, PC A17/MF A01.

This report presents the description and validation of the analytical methods for calculation of the seismic loads on an HTGR core and the core support structures. Analytical modeling, integration schemes, parameter assignment, parameter sensitivity, and correlation with test data are key topics which have been covered in detail. Much of the text concerns the description and the results of a series of scale model tests performed to obtain data for code correlation. A discussion of scaling laws, model properties, seismic excitation, instrumentation, and data reduction methods is also presented, including a section on the identification and calculation of statistical errors in the test data.

17703 (GA-A—15482) **HTGR gas turbine program. Semiannual progress report, April 1-September 30, 1978.** (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76SF70046. 252p. Dep. NTIS, PC A12/MF A01.

This report describes work performed under the gas turbine HTGR (HTGR-GT) program, Department of Energy Contract DE-AT03-76-SF70046, during the period April 1, 1978 through September 30, 1978. The work reported covers the demonstration and commercial plant concept studies including plant layout, heat exchanger studies, turbomachine studies, systems analysis, and reactor core engineering.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 17701, 17720, 17734, 17735, 17737, 17745, 17751, 17752, 17753

17704 (DOE/ET/37203—1) **Experimental evaluation of acoustic agglomerators as an air cleaning system concept for emergency use in LMFBR plants. Final report.** Shaw, D.T.; Wegrzyn, J. (State Univ. of New York, Buffalo (USA). Lab. for Power and Environmental Studies). Nov 1979. Contract EN-77-S-02-4260. 52p. Dep. NTIS, PC A04/MF A01.

In the development of the Liquid Metal Fast Breeder Reactor, a major safety problem concerns the suppression of the sodium oxides aerosol particles produced during a hypothetical core disruptive accident. Some theoretical calculations are presented concerning sonic agglomeration rates of such a system in terms of acoustic frequency, intensity and particles. The information is useful in providing some guidelines for the evaluation and design of sonic systems for LMFBR emergency applications.

17705 (ENICO—1028) **Fast reactor fission yields for ^{233}U and ^{235}U irradiated in Row 4 of EBR-II.** Maeck, W.J.; Erikson, A.L.; Tromp, R.L. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Feb 1980. Contract AC07-79ID01675. 32p. Dep. NTIS, PC A03/MF A01.

Absolute ^{233}U and ^{235}U fast reactor fission yields are given for the stable and long-lived isotopes of krypton, rubidium, strontium, zirconium, molybdenum, xenon, cesium, barium, lanthanum, cerium, neodymium, and samarium, for samples irradiated in Row 4 of the Experimental Breeder Reactor II. The principal measurement technique for the fission product isotopes was isotope dilution mass spectrometry. The number of fissions was established by summing the number of fission product atoms in the heavy mass peak.

17706 (GA-A—15647) **Gas cooled fast breeder reactor design for a circulator test facility (modified HTGR circulator test facility).** (General Atomic Co., San Diego, CA (USA)). Oct 1979. Contract AT03-76SF71023. 210p. Dep. NTIS, PC A10/MF A01.

A GCFR helium circulator test facility sized for full design conditions is proposed for meeting the above requirements. The circulator will be mounted in a large vessel containing high pressure helium which will permit testing at the same power, speed, pressure, temperature and flow conditions intended in the demonstration plant. The electric drive motor for the circulator will obtain its power from an electric supply and distribution system in which electric power will be taken from a local utility. The conceptual design decribed in this report is the result of close interaction between the General Atomic Company (GA), designer of the GCFR, and The Ralph M. Parson Company, architect/engineer for the test facility. A realistic estimate of total project cost is presented, together with a schedule for design, procurement, construction, and inspection.

17707 (HEDL-TME—79-17) **Liquid metals fire control engineering handbook.** Ballif, J.L. (comp.). (Ford, Bacon and Davis Utah, Inc., Salt Lake City (USA)). Feb 1979. Contract EY-76-C-14-2170. 159p. Dep. NTIS, PC A08/MF A01.

This handbook reviews the basic requirements of the use of liquid metals with emphasis on sodium which has the greatest current usage. It delineates the concepts necessary to design facilities both radioactive and nonradioactive for use with liquid metals. It further reviews the state-of-the-art in fire extinguishers and leak detection equipment and comments on their application and sensitivity. It also provides details on some engineering features of value to the designer of liquid metal facilities.

17708 (JAPFNR—458) **Fast breeder reactor development in Japan. Progress report, October-December 1978.** (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Jun 1979. Translation of PNC-N—251-79-04. 17p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States-Japanese Fast Reactor Exchange Program.

Information is presented on the development of the experimental fast reactor JOYO; development of the fast breeder prototype reactor MONJU; design of a demonstration reactor; reactor physics; strucutural components; instrumentation and control; sodium technology; fuel materials; safety; and steam generator.

17709 (NUREG/CR—1323) **Simulation of a thermohydraulic transient in a pipe using the COMMIX-1A computer code.** Chen, M.J.; Domanus, H.M.; Sha, W.T. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 82p. (ANL-CT—80-15). Dep. NTIS, PC A05/MF A01.

The numerical aimulation of a section of a LMFBR intermediate pipe loop during a typical CRBR scram has been carried out using the COMMIX-1A computer code. COMMIX-1A is a three dimensional, transient, sngle-phase component computer code with both Cartesian and cylindrical coordinates for thermal hydraulic analysis. A considerable top to bottom temperature differences in the pipe is found as a result of flow stratification. The top to bottom temperature difference can be as high as approximately 50% of the temperature difference of the forcing function employed in the transient.

17710 (WAPD-TM—1347) **Fuel rod-grid interaction wear: in-reactor tests (LWBR development program).** Stackhouse, R.M. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Nov 1979. Contract EY-76-C-11-0014. 61p. Dep. NTIS, PC A04/MF A01.

Wear of the Zircaloy cladding of LWBR irradiation test fuel rods, resulting from relative motion between rod and rod support contacts, is reported. Measured wear depths were small, 0.0 to 2.7 mils, but are important in fuel element behavior assessment because of the local loss of cladding thickness, as well as the effect on grid spring forces that laterally restrain the rods. An empirical wear analysis model, based on out-of-pile tests, is presented. The model was used to calculate the wear on the irradiation test fuel rods attributed to a combination of up-and-down motions resulting from power and pressure/temperature cycling of the test reactor, flow-induced vibrations, and assembly handling scratches. The calculated depths are generally deeper than the measured depths.

17711 (WAPD-TM—1392) **Out-of-pile hydriding and thermal relaxation of reactor fasteners using Zircaloy components: the REM-120 test. (LWBR Development Program).** Duenkel, D.A. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jan 1980. Contract EY-76-C-11-0014. 54p. Dep. NTIS, PC A04/MF A01.

Six different fastened joints representing the various combinations of materials in contact with Zircaloy in the Light Water Breeder Reactor (LWBR) were tested in 520°F water for 60 days to determine the out-of-pile hydriding tendencies of the Zircaloy components in the joints. No evidence of massive, accelerated hydriding was found in this test although other testing has shown that local hydriding can occur in one of the fasteners. The same six fastener designs were tested in 600°F water for 60 days to assess their load retention capability (thermal relaxation). The measured relaxation of these fasteners confirmed the predicted values for the conditions of the test.

17712 (WAPD-TM—1437) **Determination of statistically based design limits associated with engineering models. (LWBR Development Program).** Ginsburg, H. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Feb 1980. Contract EY-76-C-11-0014. 38p. Dep. NTIS, PC A03/MF A01.

This report provides a usable reference of methods and procedures for the construction of both one-sided and two-sided γ/P statistical tolerance limits for design application to both linear and nonlinear models in any number of variables.

17713 **Analysis of the differences in breeding ratio and fissile inventory between heterogeneous and homogeneous liquid-metal fast breeder reactors.** Tzanos, C.P. (Science Applications, Inc., Oak Brook, IL). *Nucl. Technol.;* **47**: No. 1, 39-50(Jan 1980).

The differences in fissile inventory and breeding ratio, with respect to the differences in fertile inventory and neutron spectrum, between equivalent heterogeneous and homogeneous configurations were analyzed. To quantify the effect of spectral changes on reaction rate ratios, a calculational scheme based on properly prepared one-group cross-section sets was used.

17714 **Effects of temperature changes on the swelling behavior of 20% cold-worked AISI type 316 stainless steel.** Foster, J.P.; Boltax, A. (Westinghouse Electric Corp., Madison, PA). *Nucl. Technol.;* **47**: No. 1, 181-188(Jan 1980).

Large swelling values associated with a gradual temperature reduction during irradiation have been observed for pressurized tubes irradiated at two initial irradiation temperatures. A comparison of the pressurized tube data with WSA-4 fuel pin cladding swelling data shows that the same behavior is observed in fuel pins subject to temperature changes during irradiation. The fuel pin data cover a large temperature interval, and this information was used to determine temperature and fluence dependencies of the observed enhanced swelling effect. The results show that the enhanced swelling with temperature reductions depends on the initial irradiation temperature, with the maximum value occurring at ~ 500°C. The data indicate that the effect saturates with fluence.

17715 (SAN—0893-T1) **Program plan: acoustic leak detection/location development at GE-ARSD.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). [nd]. Contract EY-76-C-03-0893-031. 9p. Dep. NTIS, PC A02/MF A01.

Provide the development and subsequent specification, design and testing of an acoustic leak protection system which will detect a leak within a LMFBR steam generator. The goal for this system is to be at least as rapid and no more expensive than the chemical leak detection system under development for the Clinch River Breeder Reactor Plant (CRBRP).

17716 (JAPFNR—459) **Low-cycle fatigue tests on primary coolant piping system components of fast reactors.** Imazu, A. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). [nd]. 31p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Work performed under United State-Japanese Fast Reactor Exchange Program.

The primary objectives of this series of tests are as follows: to assess the validity of the design method provided by Section III of ASME Boiler and Pressure Vessel Code with emphasis placed on low-cycle fatigue design; to make observations of propagation and penetraction behavior of fatigue cracks developed in piping components; and to collect data relating to the inspections of a fast reactor in possible use. These data consist mainly of the measurements of acoustic emission.

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

17717 (LA—8223-MS) **Space nuclear reactor power plants.** Buden, D.; Ranken, W.A.; Koenig, D.R. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

Requirements for electrical and propulsion power for space are expected to increase dramatically in the 1980s. Nuclear power is probably the only source for some deep space missions and a major competitor for many orbital missions, especially those at geosynchronous orbit. Because of the potential requirements, a technology program on space nuclear power plant components has been initiated by the Department of Energy. The missions that are foreseen, the current power plant concept, the technology program plan, and early key results are described.

REGULATION AND LICENSING

17718 (GA-A—15255) **Licensing topical report: interpretation of general design criteria for high-temperature gas-cooled reactors.** Orvis, D.D.; Raabe, P.H. (General Atomic Co., San Diego, CA (USA)). Jan 1980. Contract AT03-76ET35300. 105p. Dep. NTIS, PC A06/MF A01.

This Licensing Topical Report presents a set of General Design Criteria (GDC) which is proposed for applicability to licensing of graphite-moderated, high-temperature gas-cooled reactors (HTGRs). Modifications as necessary to reflect HTGR characteristics and design practices have been made to the GDC derived for applicability to light-water-cooled reactors and presented in Appendix A of Part 50, Title 10, Code of Federal Regulations, including the Introduction, Definitions, and Criteria. It is concluded that the proposed set of GDC affords a better basis for design and licensing of HTGRs.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

17719 (ORNL/TM—7188) **DOGS: a collection of graphics for support of discrete ordinates codes.** Ingersoll, D.T.; Slater, C.O. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 135p. Dep. NTIS, PC A07/MF A01.

A collection of computer codes called DOGS (Discrete Ordinates Graphics Support) has been developed to assist in the display and presentation of data generated by commonly used discrete ordinates transport codes. The DOGS codes include: EGAD for plotting two-dimensional geometries, ISOPLOT4 for plotting 2-D fluxes in a contour line fashion, FORM for plotting 2-D fluxes in a 3-D surface fashion, ACTUAL for calculating 2-D activities, TOOTH for calculating and plotting space-energy contributon fluxes, and ASPECT for plotting energy spectra. All of the codes use FIDO input formats and DISSPLA graphics software including the DISSPOP post processors.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 17871, 17884, 18011

CONTROL SYSTEMS

17720 (GA-A—15741) **Design and simulation of a plant control system for a GCFR demonstration plant.** Estrine, E.A.; Greiner, H.G. (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract AT03-76SF71023. 37p. (CONF-800332—2). Dep. NTIS, PC A03/MF A01.

From 4. power plant dynamics, control and testing symposium; Gatlinburg, TN, USA (17 Mar 1980).

A plant control system is being designed for a 300 MW(e) Gas Cooled Fast Breeder Reactor (GCFR) demonstration plant. Control analysis is being performed as an integral part of the plant design process to ensure that control requirements are satisfied as the plant design evolves. Plant models and simulations are being developed to generate information necessary to further define control system requirements for subsequent plant design iterations.

ENVIRONMENTAL ASPECTS

17721 (PNL—3276) **Simulation of atmospheric turbulence.** Cliff, W.C.; Hall, D.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 29p. Dep. NTIS, PC A03/MF A01.

A method is described for constructing an artificial temporal sequence of velocity values for simulating atmospheric turbulence. The method develops the conditional probability density distribution of velocity given that the previous value of velocity is known. A value is randomly selected from the conditional probability density which then serves as a known value for the next conditional probability density function. Continuing this procedure provides the desired simulated sequence of velocity values. Based upon this simulation method a program is developed for the Hewlett-Packard HP-29C hand-held calculator for simulating the longitudinal component of atmospheric turbulence during neutral or strong wind conditions.

17722 **Reactor performance evaluations revisited.** Kohn, H.W. (Ohio Power Siting Commission, Columbus). pp 150-154 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article discusses a new approach to reactor performance evaluation: graphical analysis. The author believes this to be a logical approach to capacity factor evaluations.

17723 **Dual purpose nuclear plants: potential industrial sites.** Wilkinson, B.W. (Michigan State Univ., East Lansing); Barnes, R.W. pp 155-160 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The increased necessity for efficient utilization of energy is prompting detailed studies of utility plants which produce both steam and electricity. One energy source for such systems is nuclear power which is applicable only if large steam loads (over 500,000 lbs/h within a 4-mile circle, or over 2,000,000 lbs/h within a 10-mile circle or over 4,000,000 lbs/h within a 20-mile circle) exist in one or more industrial plants. This study was conducted to locate the various industrial regions which would comply with these criteria. The published plant capacities of paper mills, chemical plants, petroleum refineries, rubber processors, and primary metals were utilized to estimate the steam requirements at each of a number of sites. It was found that over 160 sites in the United States have the potential for such operations. This project was conducted for the Oak Ridge National Laboratory.

SITING

17724 **INSITE: information on nuclear sites data system.** Huber, C.C.; Livengood, C.D.; Samsa, M.E.; Wolsko, T.D. (Argonne National Lab., IL). pp 570 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A computerized nuclear site data system (INSITE) has been developed at Argonne National Laboratory to support efforts of the US Nuclear Regulatory Commission (NRC) to develop site evaluation guidelines and to establish a general base of information for use by the NRC in other regulatory activities. It also represents a useful tool for state agencies, utilities, architect-engineers and consulting firms.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 17754

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 18011, 18077

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 17708, 17739, 17740, 17741, 17750

17725 (ANL/ENG—79-01) **TREAT MK III loop stress analysis.** Ewing, T.F. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 208p. Dep. NTIS, PC A10/MF A01.

The objective of this analysis is to predict the static behavior of the TREAT MK III loop under design conditions of thermal, pressure, and dead weight loadings, and to check that stress intensities do not exceed allowable limits. Additionally, the feasibility of two alternative sodium heat-up schemes is investigated. The analysis is performed by the ANLPIPE computer program, a three dimensional static and dynamic analysis code for piping systems. ANLPIPE employs a finite-element approach; a pipe network is modeled as a series of linear and curved beam elements subjected to dead weight, thermal, anchor, and mechanical loads.

17726 (CONF-791108—21) **Model to simulate the fission-product transport process in the Experimental Breeder Reactor II.** So, B.Y.C. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 11p. Dep. NTIS, PC A02/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

When fission products are released from a cladding breach in EBR-II, they mix turbulently with the sodium in the core, in the upper plenum and in the intermediate heat exchanger. Eventually the fission products are discharged 12 to 13 s later into the primary tank. Fission gases migrate upward through a 9-ft layer of sodium and enter the cover gas. Loss of fission gas is due to decay, leakage of cover gas, cold trapping of iodine and bromine parents. Depending on the reactor operation requirement, it may purge with fresh argon. The assumptions made and differential equations used to develop a model for such transport are presented.

17727 (CONF-791205—18) **Design and operating experience of EBR-II intermediate heat exchanger.** Buschman, H.W.; Koenig, J.F.; Stone, C.C. (Argonne National Lab., Idaho Falls, ID (USA); Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From ASME winter annual meeting; New York, NY, USA (2 Dec 1979).

Experimental Breeder Reactor II (EBR-II) has operated for over 15 years at the Idaho National Engineering Laboratory near Idaho Falls. EBR-II has served the nation in providing information on fuels, materials, and components under conditions approaching those expected for commercial power plants. In addition, EBR-II is a power plant generating electricity with an availability of about 70%. A key component, the Intermediate Heat Exchanger (IHX), of any Liquid Metal Fast Breeder Reactor (LMFBR) must perform with a high degree of reliability for successful commercialization. The design and operating experience gained from EBR-II demonstrates that the IHX can be built and operated with confidence that its performance and reliability will be satisfactory.

17728 (EGG-LO-MR—003) **LOFT monthly progress report for January 1980.** Kaufman, N.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1980. Contract EY-76-C-07-1570. 93p. Dep. NTIS, PC A05/MF A01.

During January, the LOFT Project focused on preparing for the next small-break experiment. That test, L3-2, is scheduled for February 6. The test will simulate a break size corresponding to a failure in a one-inch pipe for a 1000 MW(e) commercial power plant. It will be the second small break experiment in LOFT to use nuclear heat. Overall costs for January are very close to budget (greater than 1%). The costing rate will require continued close monitoring. The manpower rate is higher than budgeted and the material rate is less than budgeted.

17729 (EGG/LTR—141-99) **LOFT experimental support branch data abstract report: LOFT fuel rod thermocouple calibration test rod-RRF-A-8879.** Solbrig, C.W.; Tolman, E.L.; Selcho, H.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 25 Apr 1979. Contract EY-76-C-07-1570. 56p. Dep. NTIS, PC A04/MF A01.

This report presents the comparison between LOFT type thermocouples (surface mounted) and embedded thermocouples placed in comparable locations on a stainless steel clad electrically heated rod. The experiments performed on this rod simulated a hot leg break loss-of-coolant accident (LOCA) with the rods at a medium steady state power level. The maximum steady state linear heat generation rate (MLHGR) at steady state was 10 kW/ft and thus these experiments are representative of average operating power levels in PWR's. The purpose of the test was to determine the difference in temperature measured by the two types of thermocouples and from this to infer how well the LOFT thermocouple measures the surface temperature of a nuclear rod.

17730 (EGG/LTR—141-100) **LOFT experimental support branch data abstract report: LOFT fuel rod thermocouple calibration test rod RRF-A-88102.** Solbrig, C.W.; Tolman, E.L.; Selcho, H.S. (Idaho National Engineering Lab., Idaho Falls (USA)). 25 Apr 1979. Contract EY-76-C-07-1570. 50p. Dep. NTIS, PC A03/MF A01.

This report presents the comparison between LOFT type thermocouples (surface mounted) and embedded thermocouples placed in comparable locations on stainless steel clad electrically heated rod. The experiments performed on this rod simulated a hot leg break loss-of-coolant accident (LOCA) with the rods at a high steady state power level. The maximum steady state linear heat generation rate (MLHGR) was 19 kW/ft and the peak cladding temperatures ranged from 1200 to 1600°F, thus these experiments are representative of high power LOCA conditions. The purpose of the test was to determine the difference in temperature measured by the two types of thermocouples and from this to infer how well the LOFT thermocouple measures the surface temperature of a nuclear rod.

17731 (NUREG/CR—1077) **Precharacterization report for instrumented nuclear fuel assembly IFA-513.** Bradley, E.R.; Cunningham, M.E.; Daniel, J.L.; Davis, N.C.; Lanning, D.D.; Williford, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 124p. (PNL—3156). Dep. NTIS, PC A06/MF A01.

This report is a resource document covering the rationale, design, fabrication, and preirradiation characterization of instrumented fuel assembly IFA-513. This assembly is being irradiated in the Halden Boiling Water Reactor in Norway as part of the Verification of Steady-State Codes Program conducted by Pacific Northwest Laboratory and sponsored by the Fuel Behavior Research Branch of the US Nuclear Regulatory Commission. Data from this assembly will be used to better understand light water reactor fuel behavior under normal operating conditions.

17732 **Irradiation behavior of experimental Mark-II Experimental Breeder Reactor II driver fuel.** Hofman, G.L. (Argonne National Lab., IL). *Nucl. Technol.;* **47**: No. 1, 7-22(Jan 1980).

Prototypic driver-fuel elements using metallic fuel and stainless-steel cladding, designed to achieve a high burnup, were tested in the Experimental Breeder Reactor II. The irradiation results showed that burnup of up to 10 at.% can be attained without cladding failure and that cladding deformation can be kept to acceptable values if Type 316 stainless steel is used as the cladding material.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

17733 (UNI-SA—72) **Production reactor productivity improvement plan.** Leitz, E.E. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 15 Feb 1980. Contract W-7405-ENG-26. 38p. (CONF-800424—1). Dep. NTIS, PC A03/MF A01.

From American power conference; Chicago, IL, USA (21 Apr 1980).

The N Reactor complex, which is operated by UNC for DOE, is a unique facility and as such it is difficult to transfer technological developments and management innovations directly to the N Reactor operations. Therefore the approach to implementing an effective program was to start with the general systems philosophy and then progress into using those specific analytical and management techniques applicable to the unique situation (technologically and administratively) which existed at the N Reactor plant.

REACTOR SAFETY

17734 (ANL—79-89) **Quasi-Eulerian method for analyzing slug impact and coolant spillage in a fast-reactor accident.** Chu, H.Y. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 31p. Dep. NTIS, PC A03/MF A01.

This report describes a quasi-Eulerian method which has been incorporated into the ICECO code to study slug impact and coolant spillage problems in a fast-reactor accident. The quasi-Eulerian cells used in this method are located on the tops of the regular cells. The axial size of the quasi-Eulerian cells varies according to the gap generated at the reactor head-wall junction. Penetration holes on the cover head are modeled on the top center of the quasi-Eulerian cells. Fluid variables in these quasi-Eulerian cells also satisfy all the conservation equations. Since the boundary pressures above the quasi-Eulerian cells are determined by the movement of the moving grid, the velocity of the cover head is also included in the pressure iteration. Several examples are given to compare the results obtained by this quasi-Eulerian method with the existing experimental excursion data, as well as with the analytical and the other code solutions.

17735 (CONF-791204—29) **Studies related to protected loss of flow accidents in a fast breeder reactor.** Singer, R.M.; Gillette, J.L.; Mohr, D. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 12p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Intrinsic to the design of liquid-metal-cooled fast-breeder-reactors (LMFBR) are a number of physical processes which inherently contribute to the safe operation and shutdown of the plant. Natural circulation cooling of the plant following a complete loss of all on-site electrical power is analyzed. The calculations which are presented demonstrate that the reactor core is adequately and stably cooled by natural circulation for a wide range of postulated initial operating conditions and plant design parameters.

17736 (CONF-800130—1) **Statistical evaluation of design-error related accidents.** Ott, K.O.; Marchaterre, J.F. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 35p. Dep. NTIS, PC A03/MF A01.

From Workshop on the organizational and procedural aspects of management of nuclear reactor accidents; Laxenburg, Austria (28 Jan 1980).

In a recently published paper (Campbell and Ott, 1979), a general methodology was proposed for the statistical evaluation of design-error related accidents. The evaluation aims at an estimate of the combined residual frequency of yet unknown types of accidents lurking in a certain technological system. Here, the original methodology is extended, as to apply to a variety of systems that evolves during the development of large-scale technologies. A special categorization of incidents and accidents is introduced to define the events that should be jointly analyzed. The resulting formalism is applied to the development of the nuclear power reactor technology, considering serious accidents that involve in the accident-progression a particular design inadequacy.

17737 (CONF-800226—1) **Buoyancy induced flow and heat redistribution during LMFBR core decay heat removal.** Coffield R.D. Jr.; Tang, Y.S.; Killimayer, J.S.; Markley, R.A. (Westinghouse Electric Corp., Madison, PA (USA)). 1980. Contract AC15-76CL02395. 14p. Dep. NTIS, PC A02/MF A01.

From Specialists meeting on decay heat removal and natural circulation in FBR's; Upton, NY, USA (28 Feb 1980).

Natural convection cooling of the core exhibits one of the few core design transients where low power/high temperature conditions exist. Core inter-assembly and intra-assembly flow/heat redistribution: (a) become significant with regard to accurately predicting temperatures; and (b) decrease the maximum hot element temperatures. A technique is described herein for linking dynamic core-wide transient effects as predicted by COBRA-WC to the localized hot element temperatures calculated with FORE-2M. These latter temperatures are used in evaluations with regard to core design adequacy.

17738 (CONF-800332—3) **Dynamic model verification studies for the thermal response of the Fort St. Vrain HTGR Core.** Ball, S.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From 4. power plant dynamics, control and testing symposium; Gatlinburg, TN, USA (17 Mar 1980).

The safety research program for high-temperature gas-cooled reactors at ORNL is directed primarily at addressing licensing questions on the Fort St. Vrain reactor near Denver, CO. An important part of the program is to make use of experimental data from the reactor to at least partially verify the dynamic simulations that are used to predict the effects of postulated accident sequences. Comparisons were made of predictions with data from four different reactor scram (trip) events from operating power levels between 30 and 50%. An optimization program was used to rationalize the differences between predictions and measurements, and, in general, excellent agreement can be obtained by adjustment of models and parameters within their uncertainty ranges. Although the optimized models are not necessarily unique, results of the study have identified areas in which some of the models were deficient.

17739 (CONF-800502—5) **Analysis of a transient load measuring system.** Good, R.R.; Meachum, T.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 11p. Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

An analysis of the performance of a load measuring system is presented. The load system was designed to measure the weight of a pressure vessel containing high pressure and temperature water. The uncertainty and frequency response of the system are quantified for both steady state and dynamic conditions as is the repeatability of the test rig. Computation of the mass flow exiting the system during explosive decompression of the system is also presented.

17740 (EGG-LOFT—5104) **Quick-look report on LOFT nuclear experiment L3-2.** Linebarger, J.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1980. Contract EY-76-C-07-1570. 47p. Dep. NTIS, PC A03/MF A01.

Loss-of-Coolant Experiment (LOCE) L3-2, the third experiment in the Loss-of-Fluid Test (LOFT) Small Break Series L3 scheduled for performance in the LOFT facility, was successfully completed on February 7, 1980. LOCE L3-2 simulated a single-ended offset shear break of a small (1-in.-dia) pipe connected to the cold leg of a four-loop large pressurized water reactor. After experiment initiation, the primary system depressurization rate stabilized, decreasing system pressure to a point where flow from the high-pressure injection system approximated the break flow. Operator intervention, as planned, was used to reduce system pressure so that the final stage of plant cooldown could be accomplished with the purification system. The reactor system was brought to a cold shutdown condition 6.5 hours after experiment initiation.

17741 (EGG/LTR-LO—00-79-108) **Evaluation of the PBF LOFT lead rod test results concerning surface thermocouple perturbation effects.** Carboneau, M.L.; Tolman, E.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 8 Feb 1980. Contract EY-76-C-07-1570. 129p. Dep. NTIS, PC A07/MF A01.

The purpose of the PBF LOFT Lead Rod (LLR) Test program was to provide experimental data to characterize the mechanical behavior of LOFT type nuclear fuel rods under loss of coolant accident (LOCA) conditions, simulating the test conditions expected for the LOFT Power Ascension (L2) Test series. Although the LLR tests were not explicitly designed to evaluate cladding surface thermocouple perturbation effects, comparison of the Linear Variable Differential Transformer (LVDT) data for rods instrumented with and without cladding thermocouples provided pertinent information concerning the effects of cladding thermocouples on the time to DNB and time to quench data. Documentation and review of this data is presented.

17742 (EGG/YBR—34-80) **WRRD monthly report for January 1980.** Bostwick, W.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1980. Contract EY-76-C-07-1570. 161p. Dep. NTIS, PC A08/MF A01.

Information on costs, planning, and program highlights is presented concerning the semiscale program; thermal fuels behavior program; 3-d program; code development and analysis; and code assessment and applications program.

17743 (GA-A—15499) **Treatment of operator actions in the HTGR risk assessment study.** Fleming, K.N.; Silady, F.A.; Hannaman, G.W. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76ET35300. 21p. (CONF-791103—71). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Methods are presented for the treatment of operator actions, developed in the AIPA risk assessment study. Some examples are given of how these methods were applied to the analysis of potential HTGR accidents. Realistic predictions of accident risks required a balanced treatment of both beneficial and detrimental actions and responses of human operators and maintenance crews. Th essential elements of the human factors methodology used in the AIPA study include event tree and fault tree analysis, time-dependent operator response and repair models, a method for quantifying common cause failure probabilities, and synthesis of relevant experience data for use in these models.

17744 (NUREG/CR—1108) **Numerical study of condensation in cocurrent stratified flows.** Daly, B.J.; Harlow, F.H. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 28p. (LA—8077). Dep. NTIS, PC A03/MF A01.

A mathematical model of mass, momentum, and energy exchange in two-phase, separated flow is described, with application to the study of condensation processes in cocurrent, horizontally stratified, steam-water flow. Steady-state numerical solutions are obtained for a variety of steam and water inflow conditions and are compared with experimental measurements. Analysis of these results provides insight regarding the interrelationship of the various processes that influence condensation.

17745 (NUREG/CR—1123) **Fuel aerosol simulant test data record report: argon tests.** Wright, A.L.; Smith, A.M.; Rochelle, J.M.; Kress, T.S. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 67p. (ORNL/NUREG/TM—365). Dep. NTIS, PC A04/MF A01.

This data record summarizes 13 uranium dioxide (UO_2) vaporization experiments performed in an argon gas environment in the Fuel Aerosol Simulant Test (FAST) project. The FAST project is part of the ORNL Aerosol Release and Transport Program sponsored by the Division of Reactor Safety Research of the Nuclear Regulatory Commission. The argon test series was performed to determine the influence of argon gas pressure and temperature on the mass of fuel vaporized and on the fuel aerosol size distribution produced for various amounts of energy injected into the fuel sample. Included in the report are descriptions of the 13 tests along with tables and graphs summarizing the results.

17746 (NUREG/CR—1236) **Fuel swelling due to retained fission gas in molten fuel during high temperature transients.** Vinjamuri, K. (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1980. Contract EY-76-C-07-1570. 55p. (EGG—2014). Dep. NTIS, PC A04/MF A01.

Fuel swelling, which caused cladding plastic strain, occurred within the film boiling region of previously irradiated pressurized-water-reactor-type fuel rods tested under power-cooling-mismatch conditions in the Power Burst Facility. Mechanisms contributing to the observed swelling are assessed and the applicability of an analytical fission gas behavior computer code, GRASS-SST, is evaluated. Fuel melting and expansion, expansion of the solid fuel, fission gas bubble coalescence, fission gas diffusion to grain boundaries, and decrease in surface tension of fuel upon melting were found to be the major contributors to the fuel swelling. In addition, the contribution to fuel swelling of solid fission products and the effects of cladding contraction and wall thinning on rod swelling were included in the fuel swelling calculations. The overall empiricallly calculated fuel swelling values and the GRASS-SST code calculated values were compared with measured values.

17747 (SAND—79-2114C) **CORCON: a computer program for modelling molten fuel/concrete interactions.** Muir, J.F. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 22p. (CONF-800403—11). Dep. NTIS, PC A02/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A computer program modelling the interaction between molten core materials and structural concrete is being developed to provide a capability for making quantitative estimates of reactor fuel-melt accidents. The principal phenomenological models, intercomponent heat transfer, concrete erosion, and melt/gas chemical reactions, are described. A code test comparison calculation is discussed.

17748 (SAND—80-0152) **Light Water Reactor Safety Technology Program. Quarterly report, July-September 1979.** (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 64p. Dep. NTIS, PC A04/MF A01.

This quarterly report covers the period July 1 through September 30, 1979 and details the progress of the research and development projects of the Light Water Reactor Safety Technology Program of the Department of Energy (DOE). The Program is managed by Sandia Laboratories which serves as the Technology Management Center (TMC) for DOE. Under the sponsorship of the DOE Nuclear Power Development Division, the Program is intended to develop and assist implementation of light water reactor (LWR) systems and concepts which offer significant improvements in safety.

17749 (UCRL—52835) **PELE-IC test problems.** Gong, E.Y.; Alexander, E.E.; McMaster, W.H.; Quinones, D.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1979. Contract W-7405-ENG-48. 49p. Dep. NTIS, PC $8.50/MF $4.85.

This report provides prospective users of the Lawrence Livermore Laboratory (LLL) fluid-structure interaction computer code, PELE-IC, a variety of test problems for verifying the code on CDC 7600 computer systems at facilities external to the LLL environment. The test problems have been successfully run on CDC 7600 computers at the LLL and Lawrence Berkeley Laboratory (LBL) computer centers.

17750 **Effect of intrasubassembly incoherencies on the fast test reactor unprotected transient overpower accident.** Yung, S.C.; Wilburn, N.P. (Hanford Engineering Development Lab., Richland, WA). *Nucl. Technol.;* **47**: No. 1, 23-38(Jan 1980).

Intrasubassembly incoherencies affecting the fuel pin failure pattern within a fast test reactor (FTR) subassembly during an unprotected transient overpower/hypothetical core disruptive accident have been investigated using the COBRA-III/MELT code. Two dominant intrasubassembly incoherencies in an FTR subassembly were studied, namely, (a) the hydraulic effect, or the variation in pin-power-to-effective-coolant ratio between pins in the inner region and those in the outer region of the subassembly, and (b) the power skew, or variation in pinwise power density for pins throughout the subassembly.

17751 **Gravitational collision efficiency of post hypothetical core disruptive accident Liquid-Metal Fast Breeder Reactor aerosols: spherical particles.** Pertmer, G.A.; Loyalka, S.K. (Univ. of Missouri, Columbia). *Nucl. Technol.;* **47**: No. 1, 70-90(Jan 1980).

Sensitivity analyses have shown that the gravitational collision efficiency influences post hypothetical core disruptive accident aerosol behavior in liquid-metal fast breeder reactor (LMFBR) con-

tainment in important ways. Research was directed toward improving expressions for this quantity. Following the work of atmospheric sciences, dynamical equations for two particle motions were developed. A computer program GCEFF was constructed, options for using a variety of drag forces were provided, and the dynamical equations were solved by using Gear's method. Results were compared with the previous work of atmospheric sciences, and explicit results for several cases of interest in the LMFBR studies were provided.

17752 Role of fission gas and fuel melting in fuel response during simulated hypothetical loss-of-flow transients. Bandyopadhyay, G.; Buzzell, J.A. (Argonne National Lab., IL). *Nucl. Technol.;* **47**: No. 1, 91-109(Jan 1980).

Direct electrical heating (DEH) experiments have been performed to study fuel and fission gas behavior during transients with thermal conditions similar to those predicted for flow-coastdown and sodium voiding phases of a reference reactor hypothetical los-of-flow accident case. Macroscopic fuel response, such as gross fuel swelling and fuel dispersal in DEH fuel pellet stacks, was monitored during the transients. It was noted that in the presence of a mild restraint (e.g., due to quartz "cladding"), fuel melting always occurred prior to any detectable gross fuel motion in the stack. The fuel response at failure was strongly dependent on the thermal history of the simulated flow-coastdown phase and the heating rates during the subsequent phase of the transient experiments. In the presence of a mild restraint, the thermal history before fuel melting occurred in the stack strongly influenced the fuel behavior.

17753 (DOE-tr—115) **Analysis of the disassembly phase of hypothetical core disruptive accidents (HCDA) for the SNR-2000.** Maschek, W. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1979. Translation of KFK—2491, December 1977. 202p. Dep. NTIS (US Sales Only), PC A10/MF A01.

Work performed under United States-West Germany Fast Reactor Exchange Program.

During 1976 a first safety analysis of a large liquid metal fast breeder reactor (LMFBR) - the so-called SNR-2000 - has been performed in the framework of the fast breeder project. The reactor produces a thermal power of 5000 MW corresponding to 2000 MW electric. The analysis mainly dealt with the behavior of HCDAs in the SNR-2000 core. Transient over power (TOP), loss of flow (LOF), and LOF driven TOP's have been analyzed for two burn up status (begin of equilibrium cycle A (BEC-A) and end of equilibrium cycle B (EEC-B)). For these type of accidents the failure of the redundant and diversive shut down system has been assumed.

17754 Report of the President's Commission on the accident at Three Mile Island. Washington, DC; President's Commission (1979). 207p. (NP—24200). GPO $5.00.

On March 28, 1979, the United States experienced the worst accident in the history of commercial nuclear power generation. Two weeks later, the President of the United States established a Presidential Commission. The purpose of the Commission was to conduct a comprehensive study and investigation of the recent accident involving the nuclear power facility on Three Mile Island in Pennsylvania. Results and conclusions of the investigation are presented.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 17884

COMPRESSED GAS

REFER ALSO TO CITATION(S) 17810

17755 (PNL—2974) **Potential petrophysical and chemical property alterations in a compressed air energy storage porous rock reservoir.** Stottlemyre, J.A.; Erikson, R.L.; Smith, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EY-76-C-06-1830. 88p. Dep. NTIS, PC A05/MF A01.

Successful commercialization of Compressed Air Energy Storage (CAES) systems depends on long-term stability of the underground reservoirs subjected to somewhat unique operating conditions. Specifically, these conditions include elevated and time varying temperatures, effective stresses, and air humidities. To minimize the requirements for premium fuels, it may be desirable to retain the thermal energy of compression. Porous media, e.g., sandstone, may hold promise as elevated temperature reservoirs. In this study, a reservoir composed of clean quartz sandstone and injection air temperatures of 300 to 575°K are assumed. Numerical modeling is used to estimate temperature, stress, and humidity conditions within this reference porous media reservoir. A discussion on relative importance to CAES of several potential porous media damage mechanisms is presented. In this context, damage is defined as a reduction in intrinsic permeability (measure of air transport capability), a decrease in effective porosity (measure of storage capability), or an increase in elastic and/or inelastic deformation of the porous material. The potential damage mechanisms presented include: (1) disaggregation, (2) particulate plugging, (3) boundary layer viscosity anomalies, (4) inelastic microstructural consolidation, (5) clay swelling and dispersion, (6) hydrothermal mineral alteration, (7) oxidation reactions, and (8) well casing corrosion. These mechanisms are placed in perspective with respect to anticipated CAES conditions and mechanisms suggested are: (1) of academic interest only, (2) readily identified and controlled via engineering, or (3) potential problem areas requiring additional investigation.

FLYWHEELS

17756 (SAND—79-7019) **High-energy-density composite flywheel.** Satchwell, D.L.; Towgood, D.A. (AiResearch Mfg. Co., Torrance, CA (USA)). Feb 1980. Contract EY-76-C-04-0789. 113p. Dep. NTIS, PC A06/MF A01.

A flywheel has been designed and fabricated to demonstrate a high energy density of 36 w-h/lb (80 w-h/kg) in the rotor. The rotor design consists of a multiring, subcircular rim made of S-glass/epoxy composite and Kevlar/epoxy composite materials and mounted on a spoked hub made of graphite/epoxy composite materials. Two flywheel rotors are available for test.

17757 (SAND—79-7088) **Conceptual design of a flywheel energy storage system. Final report.** (Brobeck (William M.) and Associates, Berkeley, CA (USA)). Nov 1979. Contract EY-76-C-04-0789. 103p. Dep. NTIS, PC A06/MF A01.

A conceptual design of a flywheel energy storage system suitable for on-site interfacing with residential photovoltaic (PV) energy sources is developed. The basic design objective provides a generous margin of safety and above-average reliability and efficiency at the lowest practical cost. The basic design concept and the general approach to the conceptual design of the energy-storage system are described. The basic concept to interface with PV energy sources utilizes a constant voltage motor/generator directly coupled to a flywheel rotor. The voltage level of the motor is maintained at the optimum operating voltage of the array of PV cells and permits peak-power tracking. Power is withdrawn from the flywheel-driven generator when the voltage output of the array drops below its optimum value, and power is delivered to the flywheel via the generator (then operating as a motor) when the voltage rises above the optimum value. A variety of motor types and flywheel-rotor types has been studied to arrive at a conceptual design to meet the program objectives. A fiber-composite rotor driving a separately-excited motor satisfies the basic requirements. To obtain acceptable efficiency and low run-down losses, the flywheel operates in a vacuum and has a combination of magnetic-thrust support and ball bearings to reduce bearing friction in an economical fashion. The need for rotary vacuum seal is eliminated by the use of a hermetically-sealed magnetic power coupling. Cost of the system has been determined for production models to be produced in annual quantities up to one-hundred thousand for both 10-kWh and 50-kWh capacities, and also for a 10 kWh one-of-a-kind demonstration model.

THERMAL

REFER ALSO TO CITATION(S) 17606, 17607, 17608

BATTERIES

MATERIALS, COMPONENTS, AND AUXILIARIES

17758 Method to produce dry storable charged electrode plates for lead batteries. Winsel, A.; Laig-Hoerstebrock, H.; Werner, H. (to Deutsches Patentamt, Muenchen (Germany, F.R.); Varta Batterie A.G., Hannover (Germany, F.R.)). German(FRG) Patent 2,718,833/A/. 2 Nov 1978. 8p. (In German).

The object of the invention is to conserve the electrochemically active spongy lead of freshly formed negative electrode plates or to conserve the formed positive plate by protecting against carbonate formation. Spongy lead burns extraordinarily fast in the presence of air moisture and at raised temperature to lead oxide if one does not take special precautions before and during drying. According to the invention, one achieves a sufficient protection with a single immersion process by placing the electrode plates in an

immersion bath running along their surface, containing 7 to 10 wt.% boric acid, 45 to 55°C warm and having a pH value of 3 to 4.5.

17759 Negative electrode for lead accumulators and method for its fabrication. Golz, H.J. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,736,750/B/. 5 Oct 1978. 2p. (In German).

Expanders are generally used in the negative electrode plates of lead accumulators. By interfering with the lead depositing during charging, they are intended to counteract the formation of compact lead crystals and thus maintain the highly porous structure of the electrode plates. Their presence is thus indispensable for high current carrying capacity, particularly for a good cold start power of the accumulator. An expander in the form of particles in the electrode is claimed. These particles are designed to have an encapsulation whose material dissolves distributed over the lifetime of the accumulator. The expander is either encapsulated by spray drying or by liquefaction encapsulation with a water-insoluble coating.

17760 (GEPP-TIS—451) **Discharge characteristics of lithium-boron alloy anode in molten salt thermal cells.** Szwarc, R.; Walton, R.D. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 31 Mar 1980. Contract EY-76-C-04-0656. 26p. Dep. NTIS, PC A03/MF A01.

Thermal cells comprised of Li-B anodes, LiCl-KCl eutectic electrolyte, and one of three depolarizers, $CaCrO_4$, Li_2CrO_4, or FeS_2, were investigated. These cells require a separator layer to obviate direct redox reactions between the anode and the cathode. The separator developed for these cells is an electrolyte layer immobilized with MgO. MgO is inert with respect to the anode as well as other cell components. Of the three systems investigated, the Li-B/FeS_2 combination is most promising for primary thermal batteries, particularly for long-life power designs. 12 figures, 1 table.

17761 Electrode plate for lead accumulators. Jung, M.; Voss, E.; CHobanov, T. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,723,947/A/. 30 Nov 1978. 10p. (In German).

In order to reduce the lead dust occurrence in manufacturing lead accumulators, it is necessary to coat the electrodes with a dust-fastening layer. A dust-fastening coating of alkali silicate (preferably sodium silicate) is claimed. This coating contains small amounts of a thermoplastic plastic (copolymers of acrylic acid ester and styrene or of butadiene and styrene), as well as a poring agent (sugar or sodium sulphate). The further claims deal with the method to coat the dust-fastening layer.

17762 Positive electrode for lead accumulators. Winsel, A.; Voss, E. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,656,506/A/. 15 Jun 1978. 8p. (In German).

Antimony-poor or antimony-free electrode grids have not always proved suitable for accumulators subjected to strong cyclic load and occasional low discharges, because undesirable changes in the electrode mass (capacity loss, slurry formation etc.) take place with cyclic loading if antimony is missing. The undesired changes can be prevented according to the invention by incorporating antimony-supplying depositing bodies into the positive electrode mass which are designed to continuously provide antimony distributed over the lifetime of the positive electrode. The supplying bodies are granulates of preferably 400 to 800 μ diameter and consist of an antimony lead alloy of preferably 40 to 60 wt.% antimony.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 17936

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 17765, 17775, 17780, 17781, 17782, 18036

17763 (CONF-790845—, pp 160-162) **Pacific Northwest residential energy survey.** Esvelt, T.; Roberts, M. (Bonneville Power Administration, Portland, OR). 1979.

From Solar 79 Northwest conference; Seattle, WA, USA (10 Aug 1979).

Energy analysts are faced with the task of explicitly incorporating the effects of new technologies like solar heating into load forecasts. While much is being learned about the new technologies, it is paradoxical that not much is known about how energy is being used by households today. To remedy this lack of energy end-use data, an in-depth personal interview survey of 4,000 households across the Pacific Northwest will be undertaken this autumn. Information will be gathered about the dwelling characteristics, appliance ownership, economic/demographic factors, conservation practices, and energy consumption and cost. It is expected that this data base will permit detailed analyses of the current and potential future uses of wood and solar energy in existing dwellings.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 17419, 17778, 17781, 17782

17764 (CONF-800215—1) **Tomatoes, technology, and oligopsony.** Just, R.E.; Chern, W.S. (Oak Ridge National Lab., TN (USA); Brigham Young Univ., Provo, UT (USA)). Nov 1979. Contract W-7405-ENG-26. 32p. Dep. NTIS, PC A03/MF A01.

From Atlantic Economic Society annual meeting; Freeport, Bahamas (10 Feb 1980).

This paper draws on the theory of monopsony and oligopsony to develop an empirical test for the presence of the same in the situation where an exogenous shock on the relevant market may be observed. An application of this test is demonstrated for the tomato-processing industry, where the exogenous shock is created by the introduction of mechanical-harvesting technology. The results are remarkably consistent with oligopsonistic dominant firm-price leadership, and statistical tests suggest rejection of the null hypothesis of competition.

17765 (UCRL—15211) **Historical simulation with the Livermore Economic Modeling System.** Short, W.; Rambo, J.; Fullen, R. (SRI International, Menlo Park, CA (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.; Hittman Associates, Inc., Columbia, MD (USA)). Jan 1980. Contract W-7405-ENG-48. 297p. Dep. NTIS, PC 18.50/MF 4.40.

Lawrence Livermore Laboratory (LLL) has developed an Economic Modeling System (EMS) to forecast future prices and quantities of commodities of interest. This study identifies areas for possible improvement in the EMS parameters and logic through a historical simulation of energy markets between 1950 and 1975. Although this period was not one of uninterrupted free trade, the LLL modeling system proved flexible enough to reproduce historical trends at both the national and regional levels with reasonable accuracy. This report documents the data collected, details the logic problems identified, and suggests parameter values. With the implementation of the changes recommended in the study, the forecasting capability of EMS should be further improved. 143 references, 66 figures, 86 tables.

17766 Public interest, societal issues and costs involved in the implementation of the national energy plan. Deutch, M.J. pp 5-13 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The principal objectives of the National Energy Plan are discussed. These objectives include the areas of supply, demand, conservation, applied technology and facilities. Energy experts are apprehensive that specific objectives of the Plan may be unattainable because of the magnitude of tasks and constrictants in the petroleum, coal, nuclear and conservative options. Implications of unrealized objectives for US foreign and defense policies are also discussed including the trade-offs and options as they may occur in world economy, trade and stability. Two national policy objectives, energy self-reliance and concern for the environment, are discussed with regard to the difficult but unavoidable trade-offs that must occur between them. Finally, two pressing tasks for the energy planner are discussed - objective cost/benefit analysis in policy trade-offs and concern over the societal impacts of various strategies in the implementation of NEP objectives and attendant environmental controls.

17767 Standard procedure of economic evaluation for energy-producing and pollution-abatement operations. Uhl, V.W. (Environmental Protection Agency, Research Triangle Park, NC); Hawkins, A.W. pp 103-108 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses the procedure of economic evaluation. Such evaluations serve to provide comparisons of expected costs of different processes, furnish guidance for R & D activities, predict costs of specific processes, and provide industry and government bodies with estimates of the cost of proposed new technologies.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 17953, 18064

17768 Newspaper editors and environmental perceptions: a nationwide survey. Bowman, J.S. (Univ. of Wyoming, Laramie). pp 35-36 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The evidence reported shows that newspaper editors see the environmental crisis as real, but that perception does not substantially (1) change the low priority that is given to environmental stories, (2) effect editorial positions and advertising policies, nor (3) deal with various problems associated with reporting environmental news. If the nation's press is going to provide leadership in one of the most important issues in the last part of this century, it must do a more effective job of providing information to its readers. There are indications that editors are prepared to begin this important task.

17769 Application of error analysis to environmental decision making. Serth, R.W.; Hughes, T.W. (Monsanto Research Corp., Dayton, OH). pp 109-117 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The procedure described below can be aplied to a wide variety of problems in the environmental field and elsewhere. The only requirement for applicability of the method is that the decision making criterion be expressable in the form of a decision function. The data required to carry out the decision analysis procedure consist of random and systematic error bounds on each independent variable appearing in the decision function. Random error bounds (i.e., using the t-distribution). Systematic error bounds must usually be estimated based on knowledge of the process involved. For example, in field sampling work, the measurement method can be tested on standard samples to determine the basis under varying conditions. These results can then be used to estiamte bounds on the systematic error under field conditions.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 17480

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 17806

17770 Regional energy development and public participation: the case of the western North Dakota environmental assessment. Myers, P.B. (Bureau of Land Management, Billings, MT). pp 475-479 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Despite qualifications on the questionnaire findings, the overall meeting agenda, format, and feedback mechanisms have been judged very worthwhile for environmental assessment. The meetings permitted residents to get accurate information on the projects and the assessment process. Residents who attended the meetings were given the opportunity to contribute to the assessment process through two approaches, one qualitative and relatively unstructured and the other more quantitative and structured. The EIS team received guidance of a non-technical nature from the potentially impacted public. Public involvement approaches of this type can be used in budgeting of assessment attention, editorial decisionmaking, and focusing on mitigation measures of importance to the persons who would be affected. If followed by additional meaningful public involvement approaches, the credibility of the EIS document will be enhanced. The various public interests are served if the publics have accurate information on projects and are provided full opportunities to comment on their implementation. In addition, technical personnel need information from the general public to responsively fulfill the roles required of them in environmental assessment. Approaches such as the one discussed here establish a dimension of accountability too seldom in evidence in the EIS process.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 17431, 17754, 17777

17771 (RAND/R—2362-DOE) **Soviet nuclear energy: domestic and international policies.** Duffy, G. (RAND Corp., Santa Monica, CA (USA)). Dec 1979. Contract EX-76-C-01-2337. 158p. Dep. NTIS, PC A08/MF A01.

Research on Soviet nuclear export policies comprises one element of Rand's studies of comparative nuclear nonproliferation policies of major supplier nations. Soviet views on the dispersion of nuclear technology and attitudes toward the spread of nuclear weapons are rarely accorded more than a passing reference in discussions of nuclear energy and international security. But Soviet nuclear export policies are significant for a variety of reasons. The Soviet Union is the principal nuclear technology supplier to many COMECON countries, and a long-standing proponent of the Nuclear Non-Proliferation Treaty (NPT) of 1968. The Soviet Union is the largest supplier of nuclear enrichment services to Western Europe, and a supplier of heavy water to India. Soviet commitments to nuclear-fuel-cycle deployments and attitudes toward the international regulation of technology transfer can affect the efficacy of international policies designed to separate the uses of nuclear technology for electricity production and for weapons production. Analysts of Soviet energy policies, nuclear nonproliferation policies, and comparative strategies for limiting dependence on oil imports will find information in this study that is not otherwise available in convenint form in any single public report. This report is limited to information that could be obtained from public sources. 4 figures, 19 tables.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 17757, 17831

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 17686, 17815, 17817, 17820

17772 (ORNL/TM—6830/P5) **District heating/cogeneration application studies for the Minneapolis-St. Paul area: institutional issues of a new district heating/cogeneration system - ownership options, barriers, and implementation strategy.** Sundberg, R.E.; Leas, R.; Hagstrom, K.; Frost, E. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 276p. Dep. NTIS, PC A13/MF A01.

Institutional issues were identified that might affect the ownership, operation, or growth of a district-heating (DH) system in the Minneapolis-St. Paul metropolitan area. These issues included financing, taxation, regulation, pricing policy, allocation of costs and benefits between electrical generation and DH, capital-investment recovery by building owners, hookup policy, and displacement effects on existing energy suppliers. For each issue, several alternatives were identified and studied; next, various strategies (combinations of alternatives) were evaluated for their probable effect on development of the DH system. Additional economic analysis will be required to identify the best strategy.

CONSERVATION

REFER ALSO TO CITATION(S) 17795, 17797, 17799, 17800, 17801, 17802, 17803, 17804, 17806, 17813, 17939

17773 (INKA-Conf—79-171-003) **Aims, importance and limits of state support for energy saving measures.** Barth, D. (Fachinformationszentrum Energie, Physik, Mathematik G.m.b.H., Karlsruhe (Germany, F.R.)). 1979. 6p. (In German). (CONF-7906137—3). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Lecture meeting on optimized energy economy in industry; Essen, F.R. Germany (5 Jun 1979).

The various possibilities for using federal policy to limit energy consumption are discussed. After a survey of the dependence of West Germany on oil imports, the set of measures agreed by the West German Government in May 1979 are discussed. The effects on households, traffic and industry are explained.

17774 (NP—24016) **Guide for energy compatibility. Publication No. 65.** Brun, M.J.; Lefebvre, J. (Institut Francais de l'Energie, 75 -

Paris). May 1979. 160p. (In French). Dep. NTIS (US Sales Only), PC A08/MF A01.

This manual was prepared in order to guide the energy manager in the acquisition and processing of data necessary for energy conservation. Energy conservation is defined and its objectives outlined. The principles and characteristics of measurement devices used are given. The use of the measurements in the establishment of energy balances is described. Examples are given of establishments that have instituted energy-conservation plans. Tables are presented of comparative characteristics, by manufacturer and by type of measurement device, for 300 manufacturers operating in the French market. (JSR)

17775 (SIB-R—73-1979) **Model for general planning of regional energy management.** Mattsson, C. (Statens Inst. foer Byggnadsforskning, Stockholm (Sweden)). 1979. 108p. (In Swedish). Dep. NTIS (US Sales Only), PC A06/MF A01.

A model for optimizing the supply of electricity and heating in local areas is described. The time perspective is 10 to 20 years. The model is tested against the already-existing plans for two areas in the Stockholm district.

17776 **Energy conservation and improvement of the environment.** Mournighan, R.E.; Bostian, H.E. (Environmental Protection Agency, Cincinnati, OH). pp 67-73 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses a US Environmental Protection Agency (EPA) research program related to energy conservation. The program is oriented toward control needs for process changes resulting from energy conservation and toward the assessment, development, and application of energy-conserving technologies which are less polluting. Most energy-efficient processes under development are less polluting and their implementation should be encouraged and accelerated by Federal participation. This type of technology can be considered as an attractive pollution control alternative to retrofitted end-of-pipe control on conventional processes. Other energy developments, such as the increased use of high sulfur fuels, may have a negative environmental impact and also require attention. EPA is participating in energy conservation programs with the Department of Energy and other Federal agencies. Current programs cover: industrial process technology; pollution control technology; waste energy recovery; and the effects of building conservation efforts on outdoor air quality.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 17765, 17775, 17781, 17811

17777 (CONF-800212—1) **Energy futures and the concerned person.** Trauger, D.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. Dep. NTIS, PC A02/MF A01.

From 7. annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

This paper is essentially the same as CONF-790973—1. An abstract appears in EAPA 6:1200.

17778 (EPRI-EA—1241) **Power shortage costs and efforts to minimize: an example.** Mosbaek, J. (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). Dec 1979. 50p. Dep. NTIS, PC A03/MF A01.

This report presents estimates of shortage costs for a prolonged electric power shortage in Key West, Florida. Equipment failure dropped capacity 10 to 20% below peak demands for several weeks, and the isolated island system did not allow power transfer from other systems. The following willingness-to-pay estimates are discussed and presented as a complete assessment of all impacts from shortages to non-residential user: business establishment loss of $2/kWh; employee loss of 10 cents/kWh; consumer (e.g., restaurant clientele) loss of 20 cents/kWh. The residential electric power loss was only about 5 cents/kWh, but it appears to depend heavily on the conditions during the shortage. 11 references, 7 figures, 7 tables.

17779 (HCP/I1321—01/1) **Executive summary of Volume 1 of the Project Independence Evaluation System (PIES).** (Logistics Management Inst., Washington, DC (USA)). Oct 1978. Contract EA-78-X-01-1321. 42p. Dep. NTIS, PC A03/MF A01.

This document is a summary description of the Project Independence Evaluation System (PIES). It is intended for readers who wish to understand the main principles of the PIES rather than the details of its implementation. The report provides: an overview which describes the main features of the PIES; a discussion of the regional representation within the system; descriptions of the major supply and conversion sub-models; a description of available documentation; and appendices which describe the modeling of refineries and utilities in more detail. The overview provides a basic description of the PIES, with greater detail being provided in the subsequent sections of the report. The overview's emphasis is on the PIES integrating framework. The contents of this report describe past and current practices.

17780 (IKE-K—54-11) **Analysis of the model of Germany drawn up by the Pestel group, with a special view to the energy problem.** Majer, H.; Ruehle, G.; Thoene, E. (Institut fuer Angewandte Wirtschaftsforschung, Tuebingen (Germany, F.R.); Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Mar 1979. 159p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

The so-called Pestel study, The Model for Germany, covers all technical and economic aspects of energy supply in a documentation of 25 volumes supplemented by some popular publications. To obtain and evaluate the main statements of this flood of publications, the Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart, was charged with the task to make an analysis of the model for Germany by Pestel et al. The Institut for Angewandte Wirtschaftsforschung, Tuebingen, takes part in this task. The present publication, which is basically an analysis of the population, economic, and energy model, is a sequel to the Comparative and Evaluational Analysis of selected Energy Studies.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 17766, 17771, 17795, 17953

17781 (DOE/TIC—10203(App.B)) **National Energy Plan II. Appendix B: US energy projections.** (Department of Energy, Washington, DC (USA). Office of Analytical Services). May 1979. 105p. Dep. NTIS, PC A06/MF A01.

The Second National Energy Plan (NEP-II) which President Carter forwarded to the Congress on May 7, 1979, is replete with forecasts of the Nation's energy future and the impacts of that future on the American way of life. The analyses which form the basis of those forecasts are extensive and highly detailed. The reflection of these analyses in the basic NEP-II document is necessarily brief, in order that the basic document be readable, and also that the reader may maintain an appropriate perspective on the larger issues at hand. The reader should not be beguiled by the complexity and detail of computer models, nor assume that they are black boxes from which truth will somehow emerge, or which will conceal bias. It is the insights into the behavior of enery markets and perceptions of the forces that will shape those markets in the future, which drive the results. Often, those insights and perceptions must rely heavily on judgment, since basic truths and detailed data are lacking. In order that the reader may judge for herself or himself the reasonableness of the forecasts and estimated in NEP-II, this appendix describes in detail far greater than would be possible in the NEP-II report itself, the assumptions and the methods of analysis used to generate the NEP-II results. The scenarios for NEP-II are designed to illustrate two major areas of uncertainty affecting national energy planning: world oil prices; and domestic supply/demand uncertainties.

17782 (DOE/TIC—10203(App.C)) **National Energy Plan II. Appendix C: energy and the economy.** (Department of Energy, Washington, DC (USA). Office of Analytical Services). May 1979. 95p. Dep. NTIS, PC A05/MF A01.

This appendix discusses the interaction between energy and the economy in more detail than was permitted in NEP-II. Specifically, interactions between energy and the economy are analyzed in four areas: (1) macroeconomic analysis of higher oil prices; (2) macroeconomic impacts of the President's April 1979 oil price decontrol and tax proposals; (3) regional macroeconomic impacts of higher oil prices; and (4) impacts on individuals of higher oil prices. The analysis in each of the four above areas was performed in parallel prior to completion of the world oil price analysis described in Appendix A. Assumptions related to price and quantity of US oil imports are thus not consistent among the four studies. Results of the studies therefore cannot easily be compared with each other. The major models employed in this study are the following: The Data Resources, Inc. (DRI) macroeconomic model and the Dale W. Jorgenson Associates/Brookhaven National Laboratory model are the main models used in the macroeconomic analyses of the first section. The DRI energy model and the Bureau of Labor Statistics (BLS) Input-Output model were also used extensively. The regional impacts in the second section were estimated with the Chase Econometric Associates, Inc. (CEAI) regional model. The final section dealing with individual impacts utilized the Energy Information Adminstration's MATH/CHRDS model.

COAL

REFER ALSO TO CITATION(S) 17313, 17314, 17688

PETROLEUM

REFER ALSO TO CITATION(S) 17379, 17391, 17392, 17393, 17811

NATURAL GAS

REFER ALSO TO CITATION(S) 17379, 17393

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 17379

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 17467

ELECTRIC POWER

REFER ALSO TO CITATION(S) 17480, 17681, 17682, 17687, 17778

17783 Electric utility growth forecasts: an assessment. Hauck, F.; Hauck, D. (Hauck Associates, Shelbyville, KY). pp 24-29 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Similar industrial societies of Switzerland and West Germany confirm the practicality of a 30% reduction, in that they require 40% to 50% less energy consumption per capita or per dollar equivalent of their Gross National Product. Differences in cultures and affluence might prevent our reaching a 40% or 50% goal. A paper published recently, written by a nuclear engineer, a nuclear physicist and an economist, relates California's recently reduced projections. There, Southern California Edison and San Diego Gas & Electric reduced forecasts of 6.3% made in 1973 to 4.9% in 1975. Currently, the authors believe that California's electricity growth rate will hold at 3% per year indefinitely. In the past, California has been one of our fastest growing states. Tentatively, we believe that the increase in electrical demand will fall between 3% and 4%. Even modest utility growth at 3 1/2% annually will increase total electricity production from today's 2 billion kilowatt hours to about 4 1/2 billion by the year 2000, at least doubling today's number of plants. We believe that a balanced and healthy economy will need to fully utilize all of the available energy sources, whether small scale like solar heating, and small coal-fired power plants that utilize waste for steam generation, or large scale like the very large electric facilities, plus even the Synthethic Natural Gas Plants that are currently being designed.

ELECTRIC POWER GENERATION

17784 (DOE/EIA—0184/32) **Trends in the capacity utilization and fuel consumption of electric utility powerplants, 1970-1978.** Murphy, T. (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1980. 160p. Dep. NTIS, PC A08/MF A01.

This report documents an examination of recent trends in the capacity utilization and fuel consumption of electric-utility powerplants. This analysis shows that between 1970 and 1978: (1) the rate of increase in installed generating capacity exceeded the rate of increase in demand for electricity; (2) the fraction of total, installed generating capacity not operated remained virtually constant, at 1% of total capacity; (3) the average powerplant capacity factor declined from 55.3% in 1970 to 47.4% in 1978; (4) the average capacity factor for powerplants serving base load declined from 67.8% in 1970 to 64.1% in 1978; (5) the share of coal and oil burned by powerplants serving base load declined, while the share burned by powerplants serving intermediate load increased (6) the fraction of total kilowatt hours generated by powerplants serving base load declined from 82% in 1970 to 66% in 1978; (7) the nuclear share of total generation increased sharply; and (8) the natural gas share of total generation declined sharply.

SOLAR

REFER ALSO TO CITATION(S) 17483, 17484, 17485, 17607

GEOTHERMAL

REFER ALSO TO CITATION(S) 17623

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 17789, 17790

17785 (DOE/NASA/0051—79/1) **Parametric study of potential early commercial mhd power plants.** Hals, F.A. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Dec 1979. Contract EF-77-A-01-2674. 259p. (NASA-CR—159633). Dep. NTIS, PC A12/MF A01.

The major objective of this program is to develop information on the performance, cost, natural resource requirements and environmental impact, and technical feasibility and development requirements of commercial scale moderate technology MHD/steam power plants, in order to identify attractive entry level power plant designs. These attractive power plants shall have acceptable performance and acceptable cost of electricity but shall not require the development of high temperature air heaters directly fired with hot MHD generator exhaust gas. Thus, the development requirements and hence, development costs and times for these moderate technology entry level power plants is considered to be less than those for more advanced and mature power plant designs defined by previous studies such as ECAS. The parametric analysis considered the following three different reference MHD power plants: Case I: power plant with separately fired high temperature air heater and the use of state-of-the-art gasifier and heat exchanger technology; Case II: power plant with separately fired high temperature air heater and the use of advanced gasifier and heat exchanger technology; and Case III: power plant with the use of oxygen enrichment of the combustion air. The overall power system designs and the results of performance calculations for the assumed basic plant design conditions and all parametric variations are described for each reference plant separately. (WHK)

17786 (EPRI-AF—1230) **Open-cycle MHD systems analysis. Final report.** Harvey, R.A.; Maxwell, C.D.; Miller, J.L.; Demetriades, S.T. (STD Research Corp., Arcadia, CA (USA)). Nov 1979. 156p. Dep. NTIS, PC A08/MF A01.

This study investigated the power plant performance and economic characteristics of six open-cycle magnetohydrodynamics (MHD) power plant options: four with directly fired air preheaters, one with separately fired air preheaters, and one using oxygen enrichment. Using the directly fired options, the study compared the effects of high-sulfur Eastern coal and low-sulfur Western coal, sulfur emissions control by seed regeneration and by wet limestone scrubbers, and slag removal performance in the MHD combustor unit. Critical components requiring further development were identified.

17787 (FE—2363-5) **Safety evaluation of a reference design for the Magnetohydrodynamics Engineering Test Facility.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Aug 1979. Contract EF-77-C-01-2363. 204p. Dep. NTIS, PC A10/MF A01.

A safety evaluation of the AVCO Conceptual Design for the MHD Engineering Test Facility has been performed. This evaluation was carried out by application of the Failure Modes and Effects Analysis methodology used previously for other facilites being designed and constructed as part of the national MHD program. The safety evaluation was intended to achieve a preliminary identification of system, subsystem, and component failure modes having the potential for equipment damage and/or personnel injury. The evaluation was performed for the ETF Reference Design operating in the postulated full-power condition, i.e., with both MHD and bottoming plant power generation cycles, and their required auxiliary systems, in maximum power output configurations.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 17785, 17789, 17790

MATERIALS, COMPONENTS, AND AUXILIARIES

17788 (UCID—18557) **Equations of state for self-excited MHD generator studies.** Rogers, F.J.; Ross, M.; Haggin, G.L.; Wong, L.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Feb 1980. Contract W-7405-ENG-48. 24p. Dep. NTIS, PC A02/MF A01.

We have constructed a state-of-the-art equation of state (EOS) for argon covering the temperature density range attainable by currently proposed self-excited MHD generators. The EOS for conditions in the flow channel was obtained primarily by a non-ideal plasma code (ACTEX) that is based on a many body activity expansion. For conditions in the driver chamber the EOS was primarily obtained from a fluid code (HDFP) that calculates the fluid properties from perturbation theory based on the insulator interatomic pair potential but including electronic excitations. The results are in agreement with several sets of experimental data in the 0.6 - 91 GPa pressure range.

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 18115

17789 (FE—2341-9) **High Magnetic Field MHD Generator Program. Annual report, July 1, 1977-June 30, 1978.** Eustis, R.H.; Kruger, C.H.; Mitchner, M. (Stanford Univ., CA (USA). Dept. of Mechanical Engineering). Aug 1978. Contract EX-76-C-01-2341. 60p. Dep. NTIS, PC A04/MF A01.

The second year of the work on high magnetic field effects has seen improved understanding of fluctuations in MHD generators, improved diagnostics and development of techniques capable of three-dimensional spatial resolution, predictions of sidewall boundary layers for ETF size units with important variations from conventional fluid mechanics, and further improvement in channel construction techniques. All experimental work was carried on with the aim of developing techniques which will be applied to tests in the 7 tesla magnet. Improvements in diagnostic techniques for measuring temperature and electron concentration in the electrode wall boundary layer have made possible the elucidation of non-equilibrium electron concentrations in the near-wall region of the boundary layer. This improvement was partially brought about by incorporating the laboratory computer for data processing which permitted a large improvement in signal-noise ratio. Calculations based on the theory and experiments concerned with the insulating wall boundary layer were made for an ETF-size generator. Compared to a conventional boundary layer calculation which did not include Hartmann effects, the present method shows an increase in skin friction by a factor of about two and an increase in heat transfer by about 30%. Development of the disk and linear channels for experiments in the existing Stanford 6 tesla magnet continued. For both configurations a technique of brazing insulation material to a cooled substrate has been developed. Also brazing of lanthanum-chromite electrodes for the linear generator has been satisfactorily tested. The disk generator assembly will be tested in the magnet mock-up in early fall and the linear generator is scheduled for testing in early winter. (WHK)

17790 (FE—2341-13) **High Magnetic Field MHD Generator Program. Annual report, July 1, 1978-June 30, 1979.** Eustis, R.H.; Kruger, C.H.; Mitchner, M.; Self, S.A.; Koester, J.K. (Stanford Univ., CA (USA). Dept. of Mechanical Engineering). Aug 1979. Contract EX-76-C-01-2341. 64p. Dep. NTIS, PC A04/MF A01.

Progress during this year has resulted in improved understanding, through experimental and theoretical studies, of fluctuations and nonuniformities in MHD generators, development and application of a laser fluorescence method for conductivity and temperature measurement with temporal and three-dimensional spatial resolution, measurement and prediction of the effects of Joule heating in a magnetic field on the electrode boundary-layer temperature profiles and on Hall-field breakdown, and in the development of our disk and linear generator experiments for the small six Tesla magnet. Experimental and theoretical work and advanced diagnostic techniques were carried out with the aim of developing methods that will be applied to tests in the seven Tesla magnet to be supplied by the Department of Energy in support of the present program. Theoretical work has been applied to the interpretation of the experimental results and together they provide MHD design engineers with useful tools for performance predictions. During the past year the magnet shelter and MHD assembly building modifications have been completed and put into use for our current experiments.

FUEL CELLS

DESIGN AND DEVELOPMENT

17791 **Fuel cell system utilizing ion exhange membranes and bipolar plates.** Adlhart, O.J. (to Engelhard Minerals and Chemicals Corp.). US Patent 4,175,165. 20 Nov 1979. Filed date 20 Jul 1977. 12p.

Fuel cell assemblies and methods for manufacturing same are disclosed, the fuel cell assemblies comprising a stacked configuration of fuel cell laminates, each including a catalytic fuel electrode, a catalytic oxygen electrode, and an electrolyte therebetween the electrolyte comprising an ion exchange membrane, bipolar plates separating each laminate so that the opposite surfaces of each bipolar plate contacts the fuel and oxygen electrodes, respectively, fuel gas flow channel in the bipolar plate for supplying fuel to the fuel electrodes, and oxygen gas flow channels in the bipolar plates for supplying oxygen-containing gas to the oxygen electrodes, the fuel and oxygen gas flow channels being substantially perpendicular to each other. In a preferred embodiment a particular perfluorosulfonic acid membrane is employed as the electrolyte, the surfaces of the bipolar plates are treated so as to render them hydrophillic, so that water produced in the cell can be collected at the edges thereof, and the configuration of the bipolar plates is such that the diffusion paths for the oxygen-containing gas is as short as practical. The method disclosed for manufacturing such fuel cell assemblies comprises preparing the fuel cell laminates by bonding catalytic fuel electrodes and catalytic oxygen electrodes to opposite surfaces of an electrolyte member comprising an ion exchange membrane, and stacking the laminates alternatingly with the bipolar plates described above so that the plates contact fuel and oxygen electrodes on the opposite surfaces thereof, and providing means for collecting current from the top and bottom of the stacked configuration.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 17683

MATERIALS, COMPONENTS, AND AUXILIARIES

17792 (ANL—79-55) **Critical survey on electrode aging in molten carbonate fuel cells.** Kinoshita, K. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 70p. Dep. NTIS, PC A04/MF A01.

To evaluate potential electrodes for molten carbonate fuel cells, we reviewed the literature pertaining to these cells and interviewed investigators working in fuel cell technology. In this critical survey, the effect of three electrode aging processes - corrosion or oxidation, sintering, and poisoning - on these potential fuel-cell electrodes is presented. It is concluded that anodes of stabilized nickel and cathodes of lithium-doped NiO are the most promising electrode materials for molten carbonate fuel cells, but that further research and development of these electrodes are needed. In particular, the effect of contaminants such as H_2S and HCl on the nickel anode must be investigated, and methods to improve the physical strength and to increase the conductivity of NiO cathodes must be explored. Recommendations are given on areas of applied electrode research that should accelerate the commercialization of the molten carbonate fuel cell. 153 references.

17793 (DOE/NASA/0001—79/1) **Anion permselective membrane.** Alexander, S.S.; Hodgdon, R.B.; Waite, W.A. (Ionics, Inc., Watertown, MA (USA). Research Div.). Mar 1979. Contract EC-76-A-31-1002. 56p. (NASA-CR—159599). Dep. NTIS, PC A04/MF A01.

Experimental composite membranes were synthesized on a lab scale consisting of a thin layer of anion permselective resin supported by and bonded to a porous physically strong and conductive substrate film. These showed good selectivity and also substantially lower electrical resistivities than the homogenous candidate membrenes optimized in the previous contract. A wide range of resin porosities were examined for three candidate membrane systems, CD1L, CP4L, and A3L to identify the formulation giving the best overall redox cell performance. The objective was to obtain the optimum membrane porosity giving an acceptable selectivity and long range resistance stability in redox cell operation. Candidate anion membranes showed large increases in resistivity after a short time of immersion in concentrated $FeCl_3$/HCl solution. The resistance rise was attributed to exchange site fouling by the complex ions $FeCl_4^{-1}$ and $FeCl_6^{-3}$ and was found to be reversible by HCl washing. Limited quantities of two candidate membranes CD1L and CP4L (in the 10" x 10" size) were made up using several fabrics and various N.P. contents from 25 to 33%. Largely on the basis of resistance stability the CD1L formulation was selected as prime candidate and about thirty-five membranes (one foot square) were produced for experimental static and dynamic evaluation. A better appreciation of the significance of the various processing parameters was gained during this study. This improved understanding permitted us to increase the batch size and therefore the number of membranes per batch, while making substantial improvements in both uniformity and reliability.

17794 **Process for forming a fuel cell matrix.** Stewart, R.C. Jr. (to United Technologies Corp.). US Patent 4,173,662. 6 Nov 1979. Filed date 23 Dec 1977. 8p.

A process for forming a fuel cell electrolyte matrix on the surface of an electrode involves passing the electrode through a vertically falling curtain or waterfall of the matrix material carried in a liquid vehicle. The coated electrode is then heat treated to remove the liquid vehicle, leaving a layer of matrix material on the electrode surface. This curtain coating process has been used to produce

matrix layers of 2.5 mils having a variation in thickness of no more than 0.2 mils.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 17776

BUILDINGS

REFER ALSO TO CITATION(S) 17539, 17569, 17773

17795 State energy conservation construction code. Albany, NY; New York State Energy Office (1979). 97p. (NP—24348).

The New York State Energy Conservation Construction Code provides uniform regulations for the design of building envelopes to insure adequate thermal resistance and low air leakage; and for the design and selection of mechanical, electrical, and illumination systems and equipment which will enable the efficient use of energy in new and renovated public and private building construction. Following a chapter on general provisions of the code, the subjects covered ae design conditions, alternate building design; building design by component performance approach; building design by component performance approach; building design by acceptable practice; and reference standards and organizations.

17796 (SAN—1166-1) **Litek lamp evaluation program.** (Lighting Technology Corp., Burlingame, CA (USA)). Oct 1978. Contract EY-76-C-03-1166. 9p. Dep. NTIS, PC A05/MF A01.

Testing results of the Litek lamp show that a properly coated and filled electrodeless fluorescent lamp is intrinsically efficient. There is not, nor has there been, a coupling problem except when a long transmission line was improperly employed. The line then dominated the observation. Operation of a Litek lamp at 1500 lumens output with less than 25 W of raw ac input is inevitable. Further, operation is highly probable at or near the 1760 lumen level with 25 W input; or equivalently, at the 1500 lumen level with about 21 W input. The lumen maintenance of an A-25 Litek lamp will be superior to the lumen maintenance of a common heavily loaded fluorescent lamp; thus, a preliminary estimate of Litek lamp (i.e., glass part) life can be inferred from fluorescent lamp data, i.e., 9000 to 10,000 h. The interference potential of a Litek lamp is low. Operation in the ISM band at 13.56 Mhz is appropriate and legal. Bulb shielding by means of a tin oxide coating is effective.

17797 Training manual for the understanding of New York State energy conservation construction code. Albany, NY; New York State Energy Office (1979). 129p. (NP—24347).

The New York State Energy Conservation Construction Code which became effective on January 1, 1979, establishes statewide uniform regulations for the design of building envelopes to insure adequate thermal resistance and low air leakage; and for the design and selection of mechanical, electrical, and illumination systems and equipment which will provide for the efficient use of energy in new and substantially renovated public and private buildings. The Manual contains information on energy fundamentals, understanding the code, applying the code, and material identification and field inspection. Information in installing insulation, the lighting power budget, and the service water heating/space heating boilers are presented in appendices.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 17542, 17564

17798 (LBL—10117) **In-situ measurements of residential energy performance using electric co-heating.** Sonderegger, R.C.; Condon, P.E.; Modera, M.P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 22p. (CONF-800206—4). Dep. NTIS, PC A02/MF A01.

From American Society of Heating, Refrigeration, and Air Conditioning Engineers semi-annual meeting; Los Angeles, CA, USA (3 Feb 1980).

An experimental technique is presented, called electric co-heating, for measuring the net efficiency of heating and cooling systems in residential buildings. In this technique, constant temperature is maintained inside the test building by thermostated, portable electric heaters. The net heat gain from any heating system in the building is measured by the reduction in electric heating needed to maintain constant indoor temperature. The method is illustrated with actual efficiency tests of a central gas fired heating system, an open fireplace, and a central air conditioner. Other capabilities of the electric co-heating technique illustrated here are the measurement of heat load caused by air infiltration and the measurement of an equivalent conductance of the building envelope. The in-situ characteristic of the method is stressed: actual, net heat gains, and cooling and heating loads are measured, reflecting the interaction between the tested appliance and the building containing it. In this context heating efficiency improvements of a heating system can be measured whether they stem from bettered combustion efficiency or from insulation of heating ducts.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 17543

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

17799 (UCRL—15196) **Site and building energy conservation study. Low-conductivity cooling water system.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Low-conductivity cooling water is a high-quality deionized cooling water which is recirculated throughout LLL. Originally used for research apparatus, the system now supplies water for other experimental cooling equipment, shop equipment, and as a condenser cooling medium for refrigeration and air conditioning systems. Low-conductivity water is purified, cooled, and recirculated at three buildings. The system description, operation, and energy conservation opportunities are identified.

17800 (UCRL—15199) **Site and building energy-conservation study: survey of Building 361, Biomedical Laboratory.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 85p. Dep. NTIS, MF A01.

Portions of document are illegible.

An energy conservation study of Building 361, the Biomedical Laboratory, at LLL was made. The survey was based on a detailed review of the as-built drawings, several on-site inspections of the 51,000-ft^2 building, and discussions with the building manager and various operating personnel. Data were collected regarding the number of people occupying the building, operating schedules, and the energy loads imposed by installed and temporary equipment. The HVAC systems were carefully investigated. Fourteen potential energy conservation opportunities were identified, and the nine most promising ones were developed and evaluated. The building energy systems were simulated using the DOE-1 energy program.

COMMERCIAL AND INDUSTRIAL BUILDINGS

17801 (UCRL—15194) **Site and building energy-conservation study: survey of Building 113, Theoretical and Computation.** (Kaiser Engineers, Oakland, CA (USA); Consultants Computation Bureau, Oakland, CA (USA)). Oct 1979. Contract W-7405-ENG-48. vpp. Dep. NTIS, MF A01.

Portions of document are illegible.

An energy-conservation study of Building 113, Theoretical and Computation, at LLL was made. The survey of Building 113 was based on a review of the design drawings, an on-site inspection of the 88,700-ft^2 building, and discussions with the building manager and various operating personnel. Data were collected regarding the number of people occupying the building, operating schedules, and the energy loads imposed by installed and temporary equipment. The HVAC systems were investigated. The building energy systems were simulated using the DOE-1 energy program. A base-year energy-consumption run was made, together with simulations of the building's performance assuming installation of each of six energy-conservation opportunities (ECO's) identified. A summary of the energy savings that would result from implementation of the ECO's is presented.

17802 (UCRL—15195) **Site and building energy-conservation study: Survey of Building III, Experimental Physics.** (Kaiser Engineers, Oakland, CA (USA); Consultants Computation Bureau, Oakland, CA (USA)). Oct 1979. Contract W-7405-ENG-48. vpp. Dep. NTIS, MF A01.

Portions of document are illegible.

An energy-conservation study of Building III, Experimental Physics, at LLL was conducted. The survey was based on a detailed review of the as-built drawings, an on-site inspection of the 100,000-ft^2 building, and discussions with the building manager and various operating personnel. Data were collected regarding the number of people occupying the building, operating schedules, and the energy loads imposed by installed and temporary equipment. The HVAC systems were investigated. The building energy systems were simulated using the DOE-1 energy program. A base-year energy-consumption run was made, together with simulations of the building's performance assuming installation of each of nine energy conservation opportunities (ECO's) and combinations identified. A summary

of the energy savings resulting from the implementation of the ECO's is presented.

17803 (UCRL—15197) **Site and building energy-conservation study: Task II - Building Selection Study.** (Kaiser Engineers, Oakland, CA (USA); Consultants Computation Bureau, Oakland, CA (USA)). May 1979. Contract W-7405-ENG-48. 22p. Dep. NTIS, PC A02/MF A01.

The principal objectives of this study were to determine the current site and building energy usage and to identify energy-conservation opportunities at LLL. This report presents the results of Task II - Building Selection Study. The objectives of Task II were to evaluate all of the 114 permanent buildings at LLL and to select several representative buildings for detailed building energy studies performed during Task III. These detailed studies, in turn, will provide building energy-consumption data for use in the Task I - Site Energy Study. The site and building energy systems are being simulated in Tasks I and III using the DOE - 1 program which permits the evaluation of the proposed energy-conservation opportunities (ECO's) in terms of both energy and cost savings.

17804 (UCRL—15198) **Site and building energy-conservation study: survey of Building 435, MFE Research.** (Kaiser Engineers, Oakland, CA (USA); Consultants Computation Bureau, Oakland, CA (USA)). Oct 1979. Contract W-7405-ENG-48. vpp. Dep. NTIS, MF A01.

Portions of document are illegible.

An energy-conservation study of Building 435, Magnetic Fusion Energy Research, at LLL was conducted. It was based on a review of the design drawings, an on-site inspection of the 49,700-ft^2 building, and discussions with the building manager and various operating personnel. Data were collected regarding the number of people occupying the building, operating schedules, and the energy loads imposed by installed and temporary equipment. The HVAC systems were investigated. The building energy systems were simulated using the DOE-1 energy program. A base-year energy consumption run was made, together with simulations of the building's performance assuming installation of each of eleven energy-conservation opportunities (ECO's) identified. A summary of the energy savings that would results from implementation of the ECO's is given.

TRANSPORTATION

AIR AND AEROSPACE

17805 (NP—24343) **Technologies for energy conservation on the transportation sector.** Ebersbach, K.F.; Kuehnel, H.; Schaefer, H.; Schmidt, K.P.; Prechtl, H. (comps.). (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany, F.R.)). 1976. 240p. (In German). Dep. NTIS (US Sales Only), PC A11/MF A01.

A part of a BMFT-research on possibilities of energy saving are presented. Technologies of energy saving in transportation are reported. Comparative analyses deal with the problems of street transport, rail transport, air transport, and inland navigation in the FRG. The energy-related transport performance of the above transport vehicles is reported. Efficient energy savings can be achieved especially if vehicles with low specific energy consumption are given preference, i.e., the individual traffic must increasingly be replaced by mass transportation vehicles.

RAILWAY

REFER ALSO TO CITATION(S) 17805

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 17805

17806 (CONF-800419—1) **Comparison of costs for automobile energy conservation vs synthetic fuel production.** Gorman, R.; Heitner, K.L. (TRW Systems Group, McLean, VA (USA)). 1980. Contract AC01-79PE70151. 32p. Dep. NTIS, PC A03/MF A01.

From 5. symposium on automotive propulsion systems; Dearborn, MI, USA (14 Apr 1980).

This preliminary analysis suggests that there are a large number of potential technical options for reducing energy consumption in automobiles. Furthermore, the cost to the user of purchasing these conservation options is less than the discounted cost of purchasing the additional fuel required if the conservation option is not chosen. There is a significant cost savings even if fuel costs remain at current levels. These savings would increase if fuel prices continue to rise or if more costly than synthetic fuels, at least for another 15 to 20 years. Cost-effective conservation could enable new vehicles to reach 40 to 50 mpg corporate average fuel economy by the year 2000. It is clear that the potential for making these changes exists, but better data are needed to evaluate many of these options and to ensure the development and implementation of those that are desirable. Specifically, there is a need for more applied research in government and industry laboratories. Key areas for this work are discussed here for: (1) optimized engine designs, and (2) efficient vehicle body structures. 10 references, 10 figures, 3 tables.

SEA AND WATER

REFER ALSO TO CITATION(S) 17805

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 18032

17807 **Use of TVA's pipe-cross reactor to conserve energy in fertilizer granulation plants.** Salladay, D.G.; Meyers, E.D. (Tennessee Valley Authority, Muscle Shoals, AL). pp 48-53 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A new graulation process which demonstrates that energy conservation and pollution control can be accomplished primarily by internal changes in the process is described. This process simplifies the equipment necessary to produce granular fertilizers and eliminates the energy used in producing intermediate raw materials. The process works very well in the production of NPK grades and MAP of grade 12-48-0-4S. Although development is still in progress, the use of the pipe-cross reactor to produce DAP does not presently show a clear cut advantage.

17808 **Energy management in manufacturing: key to increased profits and preparation for government reporting.** Byrer, T.G.; Billhardt, C.F. (Battelle Columbus Labs., OH). pp 61-66 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper examines energy management as a cost-effective and sound business practice which will yield an immediate return through reduced manufacturing costs for industry. This effort will prepare the small businessman for future government policies and regulations which could significantly affect economic viability.

ENERGY SOURCES

17809 (COO—4236-T1) **Demonstration and testing of coal/oil mixture as a fuel for a slot furnace. Final report.** Bjerklie, J.W.; Penty, R.A. (Hague International, South Portland, ME (USA)). Jul 1979. Contract EC-77-C-02-4236. 137p. Dep. NTIS, PC A07/MF A01.

An evaluation was made of the effects of heating with a coal/oil mixture (COM) on forgings and furnace construction materials. The forgings produced with COM in a slot forge furnace were subjected to an extensive series of metallurgical tests to determine what effect, if any, use of COM as a fuel had upon the parts forged. Fifty wt % bituminous coal crushed to 80% minus 325 mesh was mixed with 50 wt % number 6 fuel oil. Emulsifiers were added to keep the coal in suspension. It was demonstrated that the 50 wt % coal/oil mixture can be successfully used to produce steel forgings. Burning COM presented no problems in respect to the ease of heating the steel or in respect to the metallurgy of the forgings. The main findings of the investigation were that: COM can be used to forge steel successfully; use of COM requires that ceramic materials of furnace construction be selected with care; and the modifications required to burn COM are minor. There were no significant differences between steel forgings produced with number 2 fuel oil and steel forgings produced with COM.

17810 (SAND—79-7077) **Industrial compressed air applications for solar energy conversion/storage devices. Final report.** McEwen, L.B.; Swain, J.W. (Sandia Labs., Albuquerque, NM (USA); Jalar Associates, San Francisco, CA (USA)). Jan 1980. Contract EY-76-C-04-0789. 162p. Dep. NTIS, PC A07/MF A01.

A survey was made of industrial compressed air installations in this country with emphasis on air usage patterns, types of equipment, and energy/power requirements. This was followed by an investigation into the technical feasibility of utilizing solar energy conversion systems to power representative industrial compressed air systems. The final task was to evaluate the economic merits of three diverse scenarios of conceptual industrial compressed-air installations. None of the three were found to be economically attrac-

tive until approximately 10 years after completion of construction with one of the primary reasons being the high capitalized cost of the associated solar powered air compression systems. A proper combination of technological improvements in solar energy conversion systems, reduced capital costs, accelerated rises in utility rates, and continued uncertainty in fossil fuel availability is regarded as necessary before further pursuit of this concept is warranted.

17811 Agricultural fuels status report. Springfield, IL; Illinois Institute of Natural Resources (1979). 17p. (NP—24273).

Both gasoline and diesel fuel appear to be in adequate supply for agricultural needs during the harvest season. Farmers use large amounts of both fuels from August through November, but their share of statewide diesel consumption is much larger than their share of gasoline. Many farms have substantial amounts of both diesel and gasoline in storage, but delays in fuel delivery would still be a potential hazard to the completion of the harvest. Delays can probably be avoided by good distribution management by fuel suppliers and, where necessary, the use of the state set-aside program to allocate fuel where it is most needed.

17812 Western energy resource development: a best fit of technologies and locations. White, I.L. (Univ. of Oklahoma, Norman); Leonard, R.L.; Plotkin, S.C. pp 355-360 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A three-year Technology Assessment of Western Energy Resource Development study is being conducted for the US Environmental Protection Agency (EPA) and is part of the Integrated Assessment Program in EPA's Office of Energy, Minerals, and Industry. This paper describes technology assessment as a kind of applied policy analysis, the substance of the Western Energy Study, and the specific objections of that study. Finally, water, one of four major impact categories considered, is used to trace the policy analytical process from problem and issue identification and definition through the evaluation of alternative policies and implementation strategies for dealing with problems and the issue conflicts to which they give rise.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 17808

17813 (COO—4649-11) **Energy conservation via heat transfer enhancement. Quarterly progress report, October 1-December 31, 1979.** Junkhan, G.H.; Bergles, A.E.; Webb, R.L. (Iowa State Univ. of Science and Technology, Ames (USA)). 1979. Contract ET-78-S-02-4649. 10p. Dep. NTIS, PC A02/MF A01.

Contacts with researchers, manufacturers, and users of enhanced heat transfer equipment are summarized. The Technical Literature file and the Patent File continue to be updated; the Patent File is the source for a patent technology report now in draft form. Application studies on a rationally-based friction correlation for internally-finned tubes and on the evaluation of candidate tube-side enhancements for OTEC applications are reported. The technology study on enhancement of spray evaporation is also discussed.

17814 (GEPP-OP—483) **High temperature furnace application of cryopumps.** McClellan, G.B. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1980. Contract EY-76-C-04-0656. 11p. (CONF-800214—2). Dep. NTIS, PC A02/MF A01.

From 9. annual symposium of the Florida Chapter of the American Vacuum Society; Tampa, FL, USA (11 Feb 1980).

The need to provide a water-free and low oxygen content insulating material for a long life thermal device made necessary a super clean vacuum furnace. The high throughput, large water capacity, and cleanliness of the cryopump seemed to make it an ideal choice for this application. The basic incompatibilities of a high temperature, 720°C, furnace and the low temperature, 12°K, cryopump were thoroughly investigated. After all the development pains, the performance of the completed system has been extensively investigated and is excellent. Cost comparisons are made with a duplicate diffusion pumped system.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 17342, 17539

17815 (DOE/NASA/1062—80/4) **Cogeneration Technology Alternatives Study (CTAS). Volume 1. Summary.** Barna, G.J.; Burns, R.K.; Sagerman, G.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jan 1980. Contract EC-77-A-31-1062. 90p. (NASA-TM—81400). Dep. NTIS, PC A05/MF A01.

CTAS compared and evaluated various advanced energy conversion systems that can use coal or coal-derived fuels for industrial cogeneration applications. The study was sponsored by the Department of Energy (DOE). Project management of the overall effort was delegated to NASA's Lewis Research Center. Most of the data were developed under contracts with two industrial teams led by the General Electric Co. and the United Technologies Corp. In addition to study management, Lewis also performed in-house analyses of the advanced systems. The Jet Propulsion Laboratory supported Lewis in selected areas. The principal aim of the study was to provide information needed by DOE to establish research and development (R and D) funding priorities for advanced-technology systems that could significantly advance the use of coal or coal-derived fuels in industrial cogeneration. Steam turbines, diesel engines, open-cycle gas turbines, combined cycles, closed-cycle gas turbines, Stirling engines, phosphoric acid fuel cells, molten carbonate fuel cells, and thermionics were studied with technology advancements appropriate for the 1985 to 2000 time period. The various advanced systems were compared and evaluated for a wide diversity of representative industrial plants on the basis of fuel energy savings, annual energy cost savings, emissions savings, and rate of return on investment (ROI) as compared with purchasing electricity from a utility and providing process heat with an on-site boiler. Also included in the comparisons and evaluations were results extrapolated to the national level.This report summarizes the results of the CTAS effort, including the contractors' and Lewis in-house results.

17816 (USDA-NC—170) **Potential for energy recovery from humid air streams.** Rosen, H.N. (Forest Service, St. Paul, MN (USA). North Central Forest Experiment Station). 1979. 10p. NTIS.

A prime consideration of the forest products industry is to reduce energy consumption. Since the drying of wood accounts for over half the energy consumed in primary manufacturing of forest products, energy saved here could be substantial. Especially promising for recovery is the energy in the humid air exhausted from dryer vents. Currently, industry usually exhausts humid air from veneer and lumber dryers directly to the atmoshere without any attempt at recovery. The potential energy available for recovery needs to be determined before the modifications to existing equipment can be justified. The purpose of this paper is to calculate the energy recoverable from vent air streams over a range of dry bulb temperatures from 200 to 3400°F and wet bulb temperatures from 100 to 212°F. The vent air is assumed to pass through a recovery (regenerative) heat exchanger where heat is transferred to another liquid or gas stream for use elsewhere in the processing plant.

17817 Utilization of power plant waste heat for sewage sludge digestion. Gordon, J.A.; Goss, L.B. (Tennessee Valley Authority, Chattanooga). pp 318-322 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

TVA has conducted several studies into practical uses of waste heat over the past several years. Sewage sludge digestion was selected for evaluation for several reasons. Sludge disposal is a costly process and represents only about 0.5% of the total liquid volume treated by a normal sewage treatment plant.

17818 Research study: waste heat recovery; opportunities in Colorado. Donaho, G.; Rogers, R. Denver, CO; Colorado Energy Conservation and Alternatives Center for Commerce and Industry (1978). 51p. (NP—24366). Colorado Energy Conservation and Alternatives Center for Commerce and Industry, 1576 Sherman Street, Denver, CO.

Options which can reduce energy consumption and the potential cost effectiveness of installing waste heat recovery equipment are discussed in a nontechnical manner. The guidebook contains five parts. Part I contains a list of 31 first-aid items that will reduce waste heat. Part II introduces sources and uses of waste heat. Part III describes commonly available equipment used to recover waste heat. Part IV presents heat recovery opportunities which should serve as a check-list of options to be analyzed, and Part V is a list of engineering and technical reference books.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 17356, 17358, 17823, 17824

17819 (DOE/ET/20023—2) **Experimental evaluation of coal conversion solid waste residuals. Progress report, August 1-October 31, 1979.** Neufeld, R.D.; Bern, J.; Erdogan, H.; Wallach, S.; Shapiro, M.A. (Pittsburgh Univ., PA (USA)). 15 Nov 1979. Contract AC22-79PC20023. 30p. Dep. NTIS, PC A03/MF A01.

Activities are underway to investigate basic phenomena that would assist demonstration and commercial sized coal conversion

facilities in the environmentally acceptable disposal of process solid waste residuals. The approach taken is to consider only those residuals coming from the conversion technology itself, i.e. from gasification, liquefaction, and hot-clean-up steps as well as residuals from the wastewater treatment train. Residuals from the coal mining and coal grinding steps will not be considered in detail since those materials are being handled in some manner in the private sector. Laboratory evalations have been conducted on solid waste samples of fly ash from an existing Capman gasifier. ASTM-A and EPA-EP leaching procedures have been completed on sieved size fractions of the above wastes. Data indicate that smaller size fractions pose greater contamination potential than do larger size particles with a transition zone occurring at particle sizes of about 0.05 inches in diameter. Ames testing of such residuals is reported. Similar studies are under way with samples of H-Coal solid waste residuals.

MUNICIPALITIES AND COMMUNITY SYSTEMS

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 17772, 17815

17820 (ORNL/SUB—79/7672/1) **Assessment of existing and prospective piping technology for district-heating applications.** Oliker, I. (Burns and Roe, Inc., Oradell, NJ (USA)). Sep 1979. Contract W-7405-ENG-26. 256p. Dep. NTIS, PC A12/MF A01.

Data on design features and operational experience of 40 hot water and steam district-heating networks with an overall heat capacity of 18,000 MWt have been collected, systematized, and analyzed. Piping networks located in Canada, Denmark, Finland, France, Italy, Japan, Netherlands, Sweden, USA, USSR, and West Germany have been analyzed and the data assembled. The data bank and analysis of the operational experience design features of hot water and steam district-heating networks are provided in Sections 2 and 3. In Section 4 the piping installation design is optimized in order to reduce costs wherever possible, without jeopardizing overall system efficiency, reliability or service life, and employing a mixture of typical US and European district-heating practices. The status of prospective non-metallic piping materials is presented in Section 5. The following materials have been investigated: fiberglass reinforced plastic, cross-linked polyethylene, polybutylene, prestressed concrete, polymer concrete, and asbestos-cement piping. (MCW)

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 17478, 17959

17821 Concepts for improving the fuel fraction of shredded solid waste. Klee, A.J. (Environmental Protection Agency, Cincinnati, OH); Hecht, N.L.; Duvall, D.S.; Fox, B.L. pp 90-95 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The technology of cellulose chemistry provides opportunities for processing the organic fraction of MSW to obtain improved products. In an EPA sponsored study at the University of Dayton processes for obtaining a carbon char and fine powdered fuel were identified. Several chemical treatments for promoting char formation at lower temperatures were studied. It would seem feasible that an effective means for producing carbon char could be achieved by a modification of the Black Clawson wet process to include chemical treatment and pyrolysis steps. It does not appear that there would be any technical problems with implementing this process. There are, however, questions about the economic viability of a process for char production. A market for the char has not been firmly defined. Any market having rigid specifications for the carbon char would not be viable due to the fluctuations in the raw MSW. Another phase of the project carried out by the University of Dayton was the identification and laboratory verification of chemical treatments for cellulose embrittlement. As a result of preliminary laboratory studies the basic requirements were defined for producing a fine powdered fuel from the organic fraction of MSW. The results of these initial studies were very encouraging and need to be extended in order to obtain more quantitative measurements of the embrittlement process parameters, and determine the problems which could be encountered from the chemical treatment of shredded MSW.

17822 Operation of the stoker boilers firing coal and refuse at Ames, Iowa. Olexsey, R.A.; Wiles, C.; Kulwicki, C.L.; Joensen, A.W.; Hall, J.L. (Environimental Protection Agency, Cincinnati, OH). pp 96-102 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Upon completion of the evaluation program at Ames, waste-to-energy system will be the most thoroughly understood and described operation in the US. The finalized data from Ames, both technical and economic, will provide valuable design information for future plants and will aid operators of existing waste-to-energy plants.

17823 Evaluation of the Ames, Iowa refuse derived fuel recovery system. Wiles, C.C.; Fiscus, D.E.; Olexsey, R.A.; Joensen, A.W.; Hall, J.L. (Environmental Protection Agency, Cincinnati, OH). pp 306-311 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Review of the Ames refuse processing plant experiences once again highlights and focuses on the materials handling problem which continues to appear when processing MSW. The need still exists for equipment better designed for handling MSW. The net costs of operating the Ames refuse facility and, thus, of refuse disposal may be considered extremely high. However, as mentioned earlier, the major factor causing this situation is the lack of sufficient refuse. Even though refuse predictions were made based upon available national data and on data from Ames' landfilling operations, they were in sufficient error to result in the poor economic situation. This situation is not necessarily unique to Ames and indicates the importance of accurate predictions of refuse quantities and qualities, and the inadequacy of currently available techniques. Additional work in this area would be useful.

17824 Thermal processing of biomass materials: technological and economic considerations. Garrett, D.E.; Vatcha, S.R. (Garrett Energy Research & Engineering, Inc., Claremont, CA). pp 312-317 of Energy and the environnment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A simple and highly efficient process for energy recovery from biomass materials has been developed by the Garrett Energy Research & Engineering Co. (GERE). The process utilizes the principles of a multiple hearth furnace containing the sequential steps of drying, pyrolysis, steam-char reaction, combustions, and air preheating. A screening-type research program in a bench scale pilot plant has been performed to study the performances of the individual steps as a function of their design parameters using cattle manure as the feedstock. The results are presented, and the optimum design conditions determined. It was found that a 450 Btu/scf (dry, CO_2-free) product gas could be obtained with about a 74% yield. It was low in carbon monoxide and should be blendable into natural gas pipelines. Based upon this data a 100 ton/d (dry basis) biomass processing plant might be built for about $1.9 million, and produce a medium-Btu gas for about $2.84/MMBtu if manure is free, after all costs, depreciation, and a 10% return on investment.

17825 Hydrogenation of municipal waste using methanol as reactant. Lu, C.C. (Univ. of Dayton, OH). pp 569 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Using municipal wastes as an energy source can partially solve both energy shortage and garbage disposal problems simultaneously. Methanol is a good hydrogen donor and also a good medium for making garbage slurry. Using methanol for a reactant with municipal wastes has a high potential applicability in converting garbages to useful fuels.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 17806

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 17834

DIESEL

17826 (DOE-tr—212) **Low emission vehicle engine based on the AD process. Final report.** Kuepper, H. (Kloeckner-Humboldt-Deutz A.G., Koeln (Germany, F.R.)). Jun 1979. Translation of Report TV 7548 A. 141p. Dep. NTIS, PC A07/MF A01.

The purpose of this project is to optimize an existing multifuel system, derived from a diesel engine (AD system of KHD), for running on gasoline only. The advantages of the diesel engine (low specific fuel consumption and low gaseous emissions) are combined with those of the Otto engine (high specific power, no soot). There are several development concepts with a single-cylinder test engine. The system selected for the transfer to the multi-cylinder engine is characterized by late mixing of fuel and air near the wall of the piston bowl. It is suitable for supercharging and its fuel consumption is typical for diesel engines. Moreover, the system has low black smoke levels and is largely insensitive to the octane and cetane numbers of the fuel. The relatively high HC and CO emissions of the system were reduced by the installation of a precious metal catalyst. The multi-cylinder engine BF 6 L 510 adapted with the Deutz-stratified charge system was installed in a Magirus-Deutz R 81 bus with which test-bed and roller dynamometer trials were carried out.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

17827 (DOE/NASA/0032—79/5) **Automotive Stirling Engine Development Program. Quarterly technical progress report, July 1-September 30, 1979.** (Mechanical Technology, Inc., Latham, NY (USA). Stirling Engine Systems Div.). Jan 1980. Contract EC-77-A-31-1040. 173p. (NASA-CR—159744; MTI—79ASE101QT6). Dep. NTIS, PC A08/MF A01.

The report summarizes the activities performed on: the Stirling Reference Engine System Design; components and subsystems; P-40 baseline Stirling engine manufacture and test; tentative specifications for the first automotive engine to be built on the program; computer development activities; technical assistance to the government. The overall program philosophy is outlined, and data and results are given. The report highlights: the extensive effort in the area of combustion and heat exchanger development; a discussion of exhaust gas recycle (EGR) and combustion gas recycle (CGR); the progress of the Engine Testing Facility at MTI; the design work of the ASE MOD I engine; and the effort performed on the Annular Regenerator at United Stirling (Sweden).

17828 (DOE/NASA/1040—80/12) **Overview of a Stirling engine test project.** Slaby, J.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract EC-77-A-31-1040. 27p. (NASA-TM—81442). Dep. NTIS, PC A03/MF A01.

The Lewis Research Center is conducting tests on three Stirling engines ranging in size from 1.33 to 53 horsepower (1 to 40 kW). The results of these tests are contributing to the development of a broad base of Stirling engine technology. In addition, the tests are directed toward developing alternative, backup component concepts to improve engine efficiency and performance or to reduce costs. Some of the activities include investigating attractive concepts and materials for cooler-regenerator units, installing a jet impingement device on a Stirling engine to determine its potential for improved engine performance, and presenting performance maps for initial characterization of Stirling engines. Some of the experimental results to date and predictions of results of tests that will be conducted on these Stirling engines are presented.

ELECTRIC-POWERED SYSTEMS

17829 (CONF-791171—1) **Impact of potential electric vehicle market penetration on air quality.** Bernard, M.J. III. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From Specialty conference on transportation and the 1977 Clean Air Act Amendment; San Francisco, CA, USA (13 Nov 1979).

Emissions to the air due to electric vehicles will result from several processes during the production, operation, and recycling and disposal of the vehicles. Some of these processes are significantly different than those for conventional vehicles. Mining and manufacturing impacts are different and larger than those for CVs due mainly to battery production and materials preparation. Battery charging will cause the greatest air pollution during the life cycle of the vehicle. Increases in SOx emissions from electric utilities in regions where coal is the major source of electricity could be significant. The CO, HC, and NOx emissions that would be produced at ground level for CVs are eliminated with EV use, however. Other battery charging emissions take place at the battery. Toxic and potentially explosive gases are emitted during charging of current technology batteries. Particulate re-entrainment by urban vehicles will not be discussed for EVs, as this phenomenon is not yet well understood in general, and because EVs are likely to be no different than CVs in this regard, but particulate emissions from tire wear are included. Emissions from recycling of the electrical component materials are likely to be recycled. Little is known about localized emissions due to vehicle accidents with battery rupture and fires.

17830 (CONS—4209-T1(Vol.7)) **Hybrid vehicle potential assessment. Volume 7. Hybrid vehicle review.** Leschly, K.O. (Jet Propulsion Lab., Pasadena, CA (USA)). 30 Sep 1979. Contract EM-78-I-01-4209. 44p. Dep. NTIS, PC A03/MF A01.

Review of hybrid vehicles (HVs) built during the past ten years or planned to be built in the near future is presented. An attempt is made to classify and analyze these vehicles to get an overall picture of their key characteristics. The review includes on-road hybrid passenger cars, trucks, vans, and buses.

17831 (DOE/CS—0026-9) **Electric and hybrid vehicle program. Quarterly report, October-December 1979.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Feb 1980. 30p. Dep. NTIS, PC A03/MF A01.

This publication reports on the enactment of legislation which offers major automobile manufacturers the alternative of including EVs in their fleets as a means of meeting prescribed Corporate Average Fuel Economy (CAFE) standards. The legislation will not have immediate impact, but it presages possible large increases of EVs in the nation's automobile population in years to come. Strides are being made in battery improvements, as reported in the feature section, EV's Reach for 100-Mile Range, and commercialization plans look to substantial production increases by 1986. Another section assesses the potential for hybrid vehicles and summarizes results of Phase 1 studies in the Near-Term Hybrid Vehicle Program. The propulsion system R and D progress is reported for component technology subsystem development.

17832 (DOE/CS/1042—1) **EVA Metro Sedan electric-propulsion system: test and evaluation.** Reimers, E. (Army Mobility Equipment Research and Development Command, Fort Belvoir, VA (USA)). Sep 1979. Contract EC-77-A-31-1042. 290p. Dep. NTIS, PC A13/MF A01.

The procedure and results of the performance evaluation of the EVA Metro Sedan (car No. 1) variable speed dc chopper motor drive and its three speed automatic transmission are presented. The propulsion system for a battery powered vehicle manufactured by Electric Vehicle Associates, Valley View, Ohio, was removed from the vehicle, mounted on the programmable electric dynamometer test facility and evaluated with the aid of a hp 3052A Data Acquisition System. Performance data for the automatic transmission, the solid state dc motor speed controller, and the dc motor in the continuous and pulsating dc power mode, as derived on the dynamometer test facility, as well as the entire propulsion system are given. This concept and the system's components were evaluated in terms of commercial applicability, maintainability, and energy utility to establish a design base for the further development of this system or similar propulsion drives. The propulsion system of the EVA Metro Sedan is powered by sixteen 6-volt traction batteries, Type EV 106 (Exide Battery Mfg. Co.). A thyristor controlled cable form Pulsomatic Mark 10 controller, actuated by a foot throttle, controls the voltage applied to a dc series field motor, rated at 10 hp @ 3800 rpm (Baldor Electric Co.). Gear speed reduction to the wheel is accomplished by the original equipment three speed automatic transmission with torque converter (Renault 12 Sedan). The brake consists of a power-assisted, hydraulic braking system with front wheel disk and rear drum. An ability to recuperate electric energy with subsequent storage in the battery power supply is not provided.

17833 (DOE/NASA/0084—79/1) **Automatically-shifted two-speed transaxle system for an electric vehicle.** Gordon, H.S.; Hassman, G.V. (Brobeck (William M.) and Associates, Berkeley, CA (USA)). Jan 1980. Contract EC-77-A-31-1044. 35p. (NASA-CR—159746). Dep. NTIS, PC A03/MF A01.

An automatic-shifting scheme for a two-speed transaxle for use with an electric vehicle propulsion system is described. The transaxle system is to be installed in an instrumented laboratory propulsion system (a breadboard) of an ac electric vehicle drive train. The transaxle which has been fabricated is also described.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 17826

17834 Secondary air supply control system. Suzuki, M.; Shiozawa, K. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,147,032. 3 Apr 1979. Priority date 21 Dec 1976, Japan, 4p.

The invention discloses a secondary air supply control system including: an air cleaner; an air pump connected to the air cleaner; a valve having a first chamber and a second chamber, which are separated by a diaphragm and communicated with each other through a first orifice, and controlling the supply of secondary air from the air pump to an exhaust manifold, in response to deflection of the diaphragm; and a passage connecting the second chamber to an intake manifold in a position downstream of a throttle valve in a carburetor and having a second orifice. In addition, a check valve which allows the flow of the secondary air only in the direction towards the exhaust manifold is provided in a passage interconnecting the valve and the exhaust manifold. In this system, an open cross-sectional area of the first orifice is smaller than that of the second orifice provided in the aforesaid passage.

17835 Transportation control plan update in Cincinnati and other cities. Ermenc, E.D. (Air Pollition Control, Cincinnati, OH). pp 30-34 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The city of Cincinnati, Ohio, has completed almost 3 years of emission testing under the Transportation Control Plan mandated to the city by USEPA. This article summarizes and compares past and present transportation control strategies. The author concludes that USEPA has done little to improve the Transportation Control Plan, and few positive benefits have been shown.

MATERIALS

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 17312

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 17848, 17867

17836 (FE—2606-8) Development of automated welding processes for field fabrication of thick-walled pressure vessels: electron beam method. Eighth quarterly report, 1 July-30 September 1979. Weber, C.M. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). 1979. Contract EF-77-C-01-2606. 29p. Dep. NTIS, PC A03/MF A01.

Objective is to develop and demonstrate an electron beam welding procedure for welding 8-inch thick SA 387 Grade 22 Class (2-1/4 Cr-1 Mo) steel. A total of 469 experimental welds have been made to date. Efforts to develop welding procedures which produce defect-free welds have been successfully completed. Techniques for acceptably starting and stopping electron beam welds were developed. Work on developing an EB repair technique is in progress. It has been learned that re-welding of holes, without metal additions, is unacceptable. Work to define the joint fit-up requirements is nearly complete. A considerable amount of joint mismatch can be readily welded and a joint gap opening in excess of 0.100 inch can be welded without alteration of the welding procedure. Another large test plate was welded using equipment with a modified drive. The weld was unacceptable due to porosity. It appears that poor base metal quality is adversely affecting weld quality. Specimens for testing the as-welded mechanical properties have been machined and are being tested.

17837 Emissivity of carburized rhenium. Pallmer, P.G. Jr.; Gordon, R.L.; Dresser, M.J. (Pacific Northwest Laboratory, Richland, Washington 99352). *J. Appl. Phys.;* **51**: No. 3, 1798-1801(Mar 1980).

Reflection techniques were used to measure the spectral emissivity at a wavelength of 0.65 μm of 30-μm-thick Re foils containing 5 at.% C. When heated to a temperature above that for saturated solubility (1900 K) so that all carbon was in solution, the emissivity was 0.420.04, the same as that of pure Re. Heating at a lower temperature caused growth of a graphitic film on the surface and the emissivity increased to 0.700.10. When subjected to intermediate temperatures, the ribbon exhibited emissivity patches, and the average emissivity under these conditions was estimated to be 0.620.04.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 17872, 17908

17838 (CONF-790248—1) Introduction. Westbrook, R.D. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 4p. Dep. NTIS, PC A02/MF A01.

From Lifetime in silicon symposium; San Diego, CA, USA (15 Feb 1979).

Separate abstracts have been prepared for items within the scope of the energy data base. The symposium was designed to bring out current thinking and activity relating to carrier lifetimes in silicon. (FS)

17839 (COO—2899-T2) Electron diffraction and microscopy studies of the structure of grain boundaries in silicon. MSC Report No. 4151. Carter, C.B.; Foell, H.; Ast, D.G.; Sass, S.L. (Cornell Univ., Ithaca, NY (USA). Materials Science Center). Feb 1980. Contract EY-76-S-02-2899. 42p. Dep. NTIS, PC A03/MF A01.

The diffraction effects expected from the periodic structure of twist boundaries in Si were determined by an examination of the reciprocal lattice of these boundaries. Methods of analysis were developed to distinguish between the real diffraction spots due to the periodic boundary structure and those due to double diffraction effects. The electron microscope images for the boundaries studied in Si bicrystals frequently were complex and contained Moire fringes which provided no information on the actual boundary structure. By analyzing the electron diffraction patterns from these boundaries for the presence of new diffraction spots it was possible to show that all the Σ1 [001], Σ1 [111], and Σ3 [111] twist boundaries examined have a periodic structure.

17840 (DOE/ER/10382—1) Study of local atomic and electronic structure in glassy metallic alloys. Progress report, March 1, 1979-December 1, 1979. Messmer, R.P.; Wong, J. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 1979. Contract AC02-79ER10382. 29p. Dep. NTIS, PC A03/MF A01.

A summary of progress on Local Atomic and Electronic Structure in Glassy Metallic Alloys is given. A brief review of structure in metallic glasses is presented as a background. The experimental progress from our EXAFS studies during the past year is summarized. The theoretical progress from our molecular orbital cluster studies of electronic structure is discussed.

17841 (SAND—9-1541C) Isotope effect on hydrogen site energies for two metal dihydrides. Venturini, E.L. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 16p. (CONF-800402—1). Dep. NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

The change in hydrogen site energy with isotope for dihydrides and dideuterides of Sc and Y has been indirectly determined using electron spin resonance (ESR) of dilute Er ions in these face-centered-cubic hosts. The ESR spectra measure the distribution of hydrogen adjacent to the Er, and the variation in this distribution with isotope and with hydrogen to metal ratio has been studied for several samples of both host metals. These data are accurately described by a lattice-gas model which yields the energy difference for protons or deuterons on octahedral and tetrahedral sites, both adjacent to the Er impurities and in the bulk host lattice. This energy difference is 10% greater for deuterons, and the change with isotope can be attributed primarily to the mass dependence of the vibrational part of the total energy associated with each site.

17842 (SAND—80-0288C) Proton interactions in vicinity of a rare earth impurity in a hydride. Richards, P.M. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 13p. (CONF-800402—3). Dep. NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

Recent rare-earth-impurity ESR in ScH/sub x/:Er has determined the fractions p_1 and p_2 of impurities which have 1 and 2 surrounding octahedral sites occupied by protons. In the absence of proton-proton interactions $p_2 \alpha p_1^2$, is expected which is in gross disagreeent with the data. It is shown that if only nearest neighbor interactions are included, p_2 should still be proportional to p_1^2, but satisfactory agreement can be obtained if both repulsive nearest-neighbor and longer range attractive interactions are included.

17843 Crystallographic texturing in Nb_3Sn multifilamentary superconducting composites. Cogan, S.F.; Rose, R.M. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *J. Appl. Phys.;* **51**: No. 3, 1711-1713(Mar 1980).

Crystallographic texturing in Nb_3Sn composites, fabricated by both the external diffusion and the commercial bronze processes, has been investigated. In the external-diffusion-processed composite the as-drawn texture of the copper matrix contained ca. 55% <111> and 45% <100>; after recrystallization at 650 °C for 16 h this changed to 70% <111> and 30% <100>. Tin plating and reaction heat treatment for 40 h at 650 °C eliminated most of the texturing. In a commercial bronze-processed composite a <211> or <221> texture was obtained in the as-drawn bronze matrix, and after a reaction heat treatment at 700 °C for 30 h a diffuse <100> texture was developed. In both composites the Nb_3Sn reaction layer exhibited no preferred orientation.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 17351, 17468, 17716, 17870, 17871, 17873

17844 (BM-RI—8411) **Iron-based alloys strengthened by ternary laves phases.** Dunning, J.S. (Bureau of Mines, Albany, OR (USA). Albany Metallurgy Research Center). 1980. 16p. Bureau of Mines, Pittsburgh, PA.

A primary goal of the Federal Bureau of Mines is to minimize the requirements for scarce mineral commodities through conservation and substitution of more abundant elements, such as iron and molybdenum. One example of this is the research effort to devise substitute materials for specialty alloys, thereby conserving nickel and chromium in high-volume stainless steels. As a possible substitute for the solid solution strengthening of chromium and nickel, the precipitation hardening characteristics of a number of binary iron-based systems in which Laves phase precipitates, such as Fe_2Mo, are formed were investigated. Several hardening responses were observed, but none were ideal. The Fe-Ta binary system had the highest magnitude of hardening, even with low alloy additions, and the Fe-Mo system had unique stability at temperature. Accordingly, the Fe-Mo-Ta system as selected for study to determine if a ternary Laves phase could combine high hardening with long-term stability at elvated temperature. Hardening and stability were reflected in excellent elevated temperature, tensile, and stress rupture strenghts. Future research will study ternary systems based on more abundant resource materials, such as the Fe-Mo-Ti system, together with additions, such as aluminum and minimal chromium, to provide oxidation resistance.

17845 (SAND—79-1833) **Compaction behavior of ten pyrotechnic materials.** Burchett, O.L.; Dietzel, R.W.; Montoya, A.P. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 16p. Dep. NTIS, PC A02/MF A01.

The compaction behavior of ten pyrotechnic materials, $KClO_4$, $Ti/KClO_4$ (33/67), $TiH_{0.65}/KClO_4$ (33/67), $TiH_{1.68}/KClO_4$ (33/67), HNAB, CP, $B/CaCrO_4$ (20/80), Pd/Al (94/6), Pd/Al (90/10), and Pd/Al (80/20), was determined by using a simple compaction test and a two-step iterative procedure to fit an assumed three parameter pressure-density relationship to the test results.

17846 **Constitutive model for metals applicable at high-strain rate.** Steinberg, D.J.; Cochran, S.G.; Guinan, M.W. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *J. Appl. Phys.;* **51**: No. 3, 1498-1504(Mar 1980).

A model, applicable at high-strain rate, is presented for the shear modulus and yield strength as functions of equivalent plastic strain, pressure, and internal energy (temperature). The parameters needed to implement the model have been determined for 14 metals. Using this model, hydrodynamic computer simulations have been successful in reproducing measured stress and free-surface-velocity—vs—time data for a number of shock-wave experiments.

17847 **Cavity growth diagram for high temperature creep.** Miller, D.A.; Langdon, T.G. (Univ. of Southern California, Los Angeles). *Scr. Metall.;* **14**: No. 2, 179-182(Feb 1980).

An alternative, simplified cavity growth diagram which directly indicates the growth process under any selected experimental conditions is presented. The diagram may be used to estimate the approximate critical radius for a transition from diffusion to power-law growth. This procedure breaks down when the cavity radius is very small ($< 1.0\ \mu m$) or when the size of the cavity is approximately equal to the grain size. (FS)

17848 **Stress state, thickness and delayed failure.** Smith, P.W.; Louthan, M.R. Jr.; McNitt, R.P. (Virginia Polytechnic Institute and State Univ., Blacksburg, VA). *Scr. Metall.;* **14**: No. 2, 199-204(Feb 1980).

The susceptibility of 43240 steel to delayed failure under hydrogen exposure is quite sensitive to macroscopic stress state and specimen thickness in bending tests. It was demonstrated that specimen design and loading will have significant effects on the apparent compatibility of the material with an aggressive environment. Any study designed to determine material compatibility must include a multi-level test program before safe, efficient materials selection can be made. (FS)

17849 **Effect of cathodic charging on creep and tensile deformation of pure iron.** Park, C.G.; Shin, K.S.; Nagakawa, J.; Meshii, M. (Northwestern Univ., Evanston, IL). *Scr. Metall.;* **14**: No. 2, 279-284(Feb 1980).

The effects of hydrogen on iron and steel was studied. Two deformation techniques illustrate the importance of strain rate. Two independent effects of H were identified. Both showed the softening effect. The introduction of H into iron polycrystalline resulted in intergranular fracture. (FS)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 17838, 17870, 17941, 18164, 18281

17850 **Hg-Xe films deposited at low temperatures: A model system for the study of the interplay between disorder and superconductivity.** Epstein, K.; Goldman, A.M.; Dahlberg, E.D.; Mikkelson, R. (University of Minnesota, Minneapolis, Minnesota 55455). EY-76-5-02-1569-A002. *AIP Conf. Proc.;* **58**: No. 1, 58-66(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

Random gaseous mixtures of Hg and Xe effusing from a molecular beam oven have been condensed onto substrates held at 4.2 K. The resultant films appear to be model systems for the study of the interplay between superconductivity and disorder brought about by increasing dilution of metallic Hg with Xe. A metal-nonmetal transition as a function of composition is observed near a volume fraction of metal close to that expected for random percolation. The increase of the resistivity near this transition is accompanied by a substantial drop in the superconducting transitions film resistances increase with decreasing temperature in a manner typical of disordered systems.

17851 (BNL—27208) **Uptake rates for hydrogen by Nb and Ta; effect of thin metallic overlayers.** Pick, M.A.; Strongin, M.; Greene, M.G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 12p. (CONF-800402—7). Dep. NTIS, PC A02/MF A01.

From International symposium on the properties and applications of metal hydrides; Colorado Springs, CO, USA (7 Apr 1980).

The hydrogen uptake rates of clean Nb and Ta foils were measured as a function of temperature and pressure. The sticking coefficient (number of hydrogen atoms entering the bulk / number of hydrogen atoms hitting the surface) of hydrogen on clean Nb and Ta, at $\simeq 2.2 \times 10^{-5}$ Torr hydrogen and room temperature, was found to be surprisingly low, $\simeq 0.005$ and $\simeq 0.05$ respectively, resulting in very low uptake rates under these conditions. This result is explained on the basis of a model recently proposed. It was found that these uptake rates can be significantly enhanced or decreased by the surface deposition of a thin layer of Pd, Pt, or Ni. The hydrogen uptake rates, i.e., sticking coefficients, were measured as a function of the overlayer thickness. In the case of Pd it was found that a layer less than one monolayer thick will either not change or even inhibit the hydrogen uptake, whereas a layer over one monolayer thick will dramatically enhance the sticking coefficient to a value of 1. It was found that the change at one monolayer is related to a phase transition of the Pd surface layer at that coverage. Both Pt and Ni do not exhibit this effect but do influence the uptake rate by an amount depending on their thickness. Thick overlayers inhibit uptake due to a limited permeation rate through the layer.

17852 (IS-T—887) **Electro- and thermotransport of carbon in iron-nickel alloys.** Okafor, I.C.I. (Ames Lab., IA (USA)). Mar 1980. Contract W-7405-ENG-82. 104p. Dep. NTIS, PC A06/MF A01.

Results of studies on the electrotransport, thermotransport and chemical diffusion of carbon in γ-phase iron - 32.5 wt % nickel alloys are described. The transport parameters, Z, Q and D were measured as a fucntion of temperature and carbon concentration and values for the activation energies for diffusion and electrotransport were obtained. The solubility limit of carbon in γ-Fe-32.5 wt % Ni for the temperature range 850 to 1200°C and the electrical resistivity versus temperature for carbon concentrations of 0.0, 0.1, 0.2, 0.5 and 0.86 wt % C between 25 and 1350°C were determined. An anomalously large mass transport effect observed in two-phase alloy during thermotransport experiments was investigated for the Fe-Ni-C system.

17853 (UCID—18558) **Hydrogen absorption by YNi_5, $LaPt_5$, and $ThNi_5$ intermetallics.** Lakner, J.F.; Takeshita, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Feb 1980. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

The absorption of H by YNi_5, $LaPt_5$ and $ThNi_5$ at pressures above those reported in the literature were studied. These alloys were reported to absorb no significant H_2 at low pressures. (FS)

17854 Radiation-enhanced diffusion growth of Nb_3Sn monofilaments: Grain-size effects on critical-current density. Snead, C.L. Jr.; Suenaga, M. (Brookhaven National Laboratory, Upton, New York 11973). *Appl. Phys. Lett.;* **36**: No. 6, 474-476(15 Mar 1980).

2-MeV electron irradiation of Nb cores in Cu-Sn bronze matrixes has produced A15 Nb_3Sn layers for irradiation temperatures between 290 and 500 °C. Growth of layers at these temperatures (below those for which Nb_3Sn is reacted thermally) results in critical-current densities that are higher than those of thermally produced specimens. Analysis of critical-current—vs—applied-field measurements shows that the increased critical-current density is consistent with smaller grain sizes in the lower-temperature enhanced diffusion grown Nb_3Sn. Although this is due in part to reduced grain growth at lower temperatures, the possibility of radiation-enhanced grain nucleation is also considered. This is the first demonstration that enhanced diffusion can be used to grow a layer of material at the interface of two dissimilar metals, the new layer being an entirely different crystal structure from the constituents forming the interface.

17855 Fermi surface of α-uranium. Schirber, J.E.; Arko, A.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). AT(29-1)-789. *Phys. Rev., B: Condens. Matter;* **21**: No. 6, 2175-2179(15 Mar 1980).

Pressures above 8 kbar have been shown to quench the low-temperature phase changes in U permitting retention of the α-U phase to liquid-He temperatures. Field-modulation de Haas—van Alphen measurements are then possible at pressures >8 kbar for fields in the 50—100-kOe range. The angular variations of four frequencies in the range of (1—2) x 10^7 G have been determined in the three inequivalent principal planes. All frequencies appear to arise from open sheets of the Fermi surface. Effective masses were measured for the minimum-area directions. These results are compared with a recent band-structure calculation of Freeman, Koelling, and Watson-Yang.

17856 Spectroscopic determination of surface geometry: Ti(0001)-H(1 x 1). Feibelman, P.J.; Hamann, D.R. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1385-1393(15 Feb 1980).

The electronic structure of a Ti(0001) film covered by a monolayer of H is shown to depend strongly on the location of the H atom in the surface unit cell. Best agreement with experiment is found with the H's in three-fold sites, 0.8 a.u. outside the outer Ti layer. In this geometry the H atoms "heal" the surface: the clean Ti(0001) surface state near the Fermi level is removed and the outer layer d-like local density of states (LDOS) is quite similar to that of the interior. Additionally, the calculated work function is 4.0 eV and an H-derived peak in the calculated LDOS appears 5 eV below E/sub F/, in agreement with photoemission measurements.

17857 Spectroscopy of a surface of known geometry: Ti(0001)-N(1 x 1). Feibelman, P.J.; Himpsel, F.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1394-1399(15 Feb 1980).

In order to test the low-energy electron diffraction (LEED) "underlayer" geometry of the Ti(0001) -N(1 x 1) system we have carried out self-consistent electronic-structure calculations and a variety of ultraviolet-photoemission-spectroscopy measurements. The assumption of the Shih et al. underlayer geometry yields the correct N-2p level ordering at Γ and the correct directions of dispersion along Γ-M. The positions of these levels are calculated to within 0.7 eV. The Fermi-level surface state predicted earlier for clean Ti(0001) is observed experimentally and, as predicted by the present calculations, is not quenched as the N adlayer forms. This result indicates that the outer Ti layer screens the potential due to N quite effectively. A layer of H on the Ti(0001) surface is found to quench the Fermi-level surface state, as predicted in the overlayer calculations of Feibelman and Hamann.

17858 Photoemission from Yb: Valence-change-induced Fano resonance. Johansson, L.I.; Allen, J.W.; Lindau, I.; Hecht, M.H.; Hagstroem, S.B.M. (Stanford Synchrotron Radiation Laboratory, Stanford, California 94305). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1408-1411(15 Feb 1980).

Photoemission and photon-absorption results on clean and oxidized Yb are presented that clearly reveal a difference in 4f occupancy between the clean ($4f^{14}$) and oxidized ($4f^{13}$) case. For the oxidized metal a resonance enhancement of the 4f-electron emission is observed at the 4d threshold. The enhancement arises from autoionization decay following 4d $\rightarrow$ 4f absorption transitions. The resulting line profile is shown to be well described by Fano's theory of interaction between a discrete and continuum state.

17859 Angular terms in the optical potential: Effect on photoemission from a model (100) surface of aluminum. Rasolt, M.; Davis, H.L. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1445-1448(15 Feb 1980).

Recently derived angular terms in the optical potential are studied in a model calculation for photoemission from the Al(100) surface. The results clearly demonstrate the importance of these contributions, and indicate that they must be included in detailed investigations.

17860 Electronic configuration and electric field gradient in Au complexes. Sham, T.K.; Watson, R.E.; Perlman, M.L. (Departments of Chemistry and Physics, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1457-1461(15 Feb 1980).

Using the relativistic Hartree-Fock method and a renormalized-atom scheme, we have calculated $\langle r^{-3} \rangle$ values for the 6p and 5d orbitals of Au in several configurations. The object of renormalization is to deal with orbitals localized at the Au site rather than with functions extending well out into the surrounding lattice, as is the case when a free-atom Au-6p function is used to represent the 6p orbital character in a crystal. We find that while $\langle r^{-3} \rangle$/sub 5d/ values are relatively insensitive to the renormalization, $\langle r^{-3} \rangle$/sub 6p/ values obtained from calculations renormalized to the Wigner-Seitz radius of Au are larger by factors of 2 to 4 than those from free-atom calculations. Renormalized $\langle r^{-3} \rangle$/sub 6p/ values, in contrast to those for the free atom, considerably exceed $\langle r^{-3} \rangle$/sub 5d/ values and are less sensitive to variation of electronic configuration. Using the renormalized $\langle r^{-3} \rangle$/sub 6p/, we have been able to interpret the large Moessbauser quadrupole splittings observed in covalent Au(I) compounds in terms of σ bonding. Other implications from these results are discussed.

17861 H on Mo(100): Photoemission result and its significance to the correlation between the surface resonances and the surface reconstruction. Weng, S.; Gustafsson, T.; Plummer, E.W. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev. Lett.;* **44**: No. 5, 344-348(4 Feb 1980).

Photoemission indicates that the surface resonances on Mo(100) are not removed entirely by the adsorption of H_2. It also shows two H-induced states below the bulk d-band edge with the binding energies independent of coverage and in good agreement with a calculation. The results indicate that H on Mo(100) is bridge bonded with the local bonding configuration relatively unchanged by reconstruction. A significant correlation between the surface resonances and the surface reconstruction is suggested.

17862 Layered ultrathin coherent structure. Schuller, I.K.; Falco, C.M. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *AIP Conf. Proc.;* **58**: No. 1, 197-202(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

We describe a new class of superconducting materials, layered Ultrathin Coherent Structures (LUCS). These materials are produced by sequentially depositing ultrathin layers of materials using high rate magnetron sputtering or thermal evaporation. We present strong evidence that layers as thin as 10 A can be prepared in this fashion. Resistivity data indicates that the mean free path is layer thickness limited. A strong disagreement is found between the experimentally measured transition temperatures T/sub c/ and the T/sub c/'s calculated using the Cooper limit approximation. This is interpreted as a change in the band structure or the phonon structure of the material due to layering or to surfaces.

17863 Magnetic field dependence of the pair potential in inhomogeneous superconductors. Finnemore, D.K.; Hsiang, T.Y. (Ames Laboratory-USDOE and Department of Physics, Iowa State University, Ames, Iowa 50011). *AIP Conf. Proc.;* **58**: No. 1, 203-206(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

The depairing effects on an applied magnetic field have been studied for inhomogeneous superconductors by measuring the critical currents of SNS junctions. Critical currents are found to decrease exponentially with increasing H over 3 orders of magnitude change in I/sub c/. If the depairing parameter is taken to be $\alpha = D/\text{sub } N/eH/C$, one finds a diffusivity of 0.22 m^2s^{-1} which agrees with the value from resistivity to an accuracy of about 30%.

17864 Search for new mechanisms of superconductivity in ultra thin films: The effect of interface and fluctuation phenomena. Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *AIP Conf. Proc.;* **58**: No. 1, 216-226(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

A discussion is given of superconductivity in ultra-thin films with emphasis on various phenomena which affect the T/sub c/ of these films. The effects of the substrate and interface are discussed and are shown to have a great influence on the T/sub c/ in many cases.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 17351, 17465, 17466, 17468, 17711

17865 (BDX—613-2312) **Effects of humidity during photoprocessing on thin film metallization adhesion.** Norwood, D.P. (Bendix Corp., Kansas City, MO (USA)). Mar 1980. Contract EY-76-C-04-0613. 46p. Dep. NTIS, PC A03/MF A01.

Humidity effects during photoprocessing on tantalum/chromium/gold thin film networks (TFNs) were investigated. Humidity conditions at various process steps were controlled by placing either desiccant or water in handling containers for the TFNs. The TFNs photoprocessed in humid conditions had a much higher occurrence of metallization failures compared to TFNs processed in dry conditions. Ceramic surface defects were shown to cause pores in the thin films, and these pores enhanced corrosion susceptibility for the films. This study resulted in a desiccated storage process for production of TFNs.

17866 (CONF-800305—6) **Stress corrosion cracking of zirconium in nitric acid.** Beavers, J.A.; Griess, J.C.; Boyd, W.K. (Battelle Columbus Labs., OH (USA); Oak Ridge National Lab., TN (USA); Battelle Houston Operations, TX (USA)). 1980. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

From Corrosion/80 NACE meeting; Chicago, IL, USA (6 Mar 1980).

The susceptibility of zirconium and its common alloys to stress corrosion cracking (SCC) in nitric acid was investigated by slow strain-rate and constant deflection techniques. Cracking occurred at 25°C over a wide range of acid concentrations and electrochemical potentials. The crack velocity increased slightly with increasing temperature. The failure mode was transgranular and the morphology was similar to SCC failures of zirconium alloys in other environments. The fracture was very orientation-dependent suggesting that it occurs on a single crystallographic plane in the material. The results of the study are not consistent with a hydrogen mechanism for cracking.

17867 (COO—2899-T1) **Preparation of Schottky diodes for EBIC investigation of grain boundary passivation in Si ribbons.** Ast, D.G.; Sullivan, T. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Oct 1979. Contract EY-76-S-02-2899. 16p. Dep. NTIS, PC A02/MF A01.

The preparation of Schottky diodes for repeated EBIC investigations of the same area is described. Application of the technique to the study of grain-boundary passivation with atomic hydrogen shows that the degree of passivation varies strongly from boundary to boundary.

17868 (DOE/ER/10404—1) **Fundamental studies of high-temperature corrosion reactions. Fifth annual progress report.** Rapp, R.A. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Feb 1980. Contract AC02-79ER10404. 83p. Dep. NTIS, PC A05/MF A01.

The in-situ study of metal oxidation reactions and the mechanism of the sulfidation of molybdenum by sulfur gases were studied. Equipment including a SEM microscope, heater and power supply which were used is described. (FS)

17869 (SAND—79-1896) **Corrosion aspects of cold smoke generation.** Weirick, L.J.; Plugge, M.M. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

Corrosion tests were performed during cold smoke generation tests. Test methods included aluminum-plate specimen observation, active and passive pH measurements and relative humidity measurements. Additional laboratory tests were conducted with controlled environments to produce an analogous corrosion response on aluminum as was observed during special application smoke tests. These tests indicate that the worst corrosion from $TiCl_4/NH_4OH$ cold smoke generation will occur close to the ceiling of the enclosure where HCl gas is in higher concentrations, where there are clinging smoke particles, and where the humidity is at saturation.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 17714, 17854

17870 (GA-A—15749) **Assessment of martensitic steels as structural materials in magnetic fusion devices.** Rawls, J.M.; Chen, W.Y.K.; Cheng, E.T.; Dalessandro, J.A.; Miller, P.H.; Rosenwasser, S.N.; Thompson, L.D. (General Atomic Co., San Diego, CA (USA)). Jan 1980. Contract AT03-76ET51011. 59p. Dep. NTIS, PC A04/MF A01.

This manuscript documents the results of preliminary experiments and analyses to assess the feasibility of incorporating ferromagnetic martensitic steels in fusion reactor designs and to evaluate the possible advantages of this class of material with respect to first wall/blanket lifetime. The general class of alloys under consideration are ferritic steels containing from about 9 to 13 percent Cr with some small additions of various strengthening elements such as Mo. These steels are conventionally used in the normalized and tempered condition for high temperature applications and can compete favorably with austenitic alloys up to about 600°C. Although the heat treatment can result in either a tempered martensite or bainite structure, depending on the alloy and thermal treatment parameters, this general class of materials will be referred to as martensitic stainless steels for simplicity.

17871 (HEDL-SA—1924-FP) **Effects of composition on the in-reactor creep of AISI 316.** Bates, J.F.; Gilbert, E.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1979. Contract EY-76-C-14-2170. 16p. (CONF-800226—3). Dep. NTIS, PC A02/MF A01.

From Specialists meeting on decay heat removal and natural circulation in FBR's; Upton, NY, USA (28 Feb 1980).

In-reactor tests designed to provide information on the relationship between compositional variations and irradiation-induced swelling and creep have achieved an exposure of 4.6×10^{22} n/cm^2 ($E > 0.1$ MeV) at 450°C. Postirradiation diametral measurements of pressurized tube specimens have indicated that irradiation-induced creep of 316 stainless steel can be modified by compositional variations of minor alloying elements. There is a general trend for specimens with higher swelling to exhibit higher creep. Silicon, phosphorus and molybdenum all retard in-reactor creep and inhibit irradiation-induced swelling as well. However, the relationship between creep and swelling is strongly composition dependent. The data suggest that carbon and nitrogen act synergistically the major influence being the nitrogen concentration. The irradiation-induced creep is insensitive to cobalt variations to the fluences investigated.

17872 **Cavity alignment and precipitation in solution annealed 316 SS during dual ion bombardment.** Wood, S. (Westinghouse Research and Development Center, Pittsburgh, PA); Spitznagel, J.A.; Choyke, W.J.; Doyle, N.J.; McGruer, J.N.; Townsend, J.R. *Scr. Metall.;* **14**: No. 2, 211-214(Feb 1980).

Some microstructural observations from solution annealed SA 316 SS after dual ion bombardment are presented which reveal a tendency for cavity alignment and enhanced cavity growth and coalescence under specific helium damage and temperature conditions. It is suggested that this excessive swelling is intimately linked with acicular precipitate formation which induces cavity alignment. (FS)

17873 **Solid solution softening and hardening in the Nb-O system.** Bang, G.W.; Nagakawa, J.; Meshii, M. (Northwestern Univ., Evanston, IL). *Scr. Metall.;* **14**: No. 2, 289-292(Feb 1980).

It is demonstrated that, in niobium, the interstitial O atoms cause the softening and hardening effect similar to the self-interstitials generated by low temperature electron irradiation. The stress-strain curves of crystals with two tensile axis orientations are shown. Their deformation behavior was quite different. (FS)

CERAMICS, CERMETS, AND REFRACTORIES

PREPARATION AND FABRICATION

17874 (PNL—3263) **Optimization of thorium oxalate precipitation conditions relative to thorium oxide sinterability.** White, G.D.; Bray, L.A.; Hart, P.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-1830. 32p. Dep. NTIS, PC A03/MF A01.

The effect of thorium oxalate precipitation conditions on derived oxide sinterability was investigated with the objective of producing ThO_2 powder that could be sintered to high density without premilling. Precipitation conditions examined were temperature, digestion time and agitation method which were employed in a two-level factorial experimental design to delineate their effects. The two levels for each of the factors, respectively, were 10°C and 70°C, 15 min and 360 min, and mechanical stirrer and a homogenizer that imparted both mechanical and ultrasonic agitation. The ThO_2 derived from each of the precipitation trials was characterized with respect to morphology, surface area, and crystallite size as well as sinterability. Only precipitation temperature had a significant effect upon all the properties of the derived oxide powders.

STRUCTURE AND PHASE STUDIES

17875 (CONF-7706168—, pp 39p, Paper B1) **Comparison of the thermodynamic properties and high temperature chemical behavior of lanthanide and actinide oxides.** Ackermann, R.J.; Rauh, E.G. (Argonne National Lab., IL). 1977.

From Conference on materials for high temperature energy sources; Odeillo, France (27 Jun 1977).

The thermodynamic properties of the lanthanide and actinide oxides are examined, compared, and associated with a variety of high temperature chemical behavior. Trends are cited resulting from a number of thermodynamic and spectroscopic correlations involving solid phases, species in aqueous solution, and molecules and ions in the vapor phase. Inadequacies in the data and alternative approaches are discussed. The characterization of nonstoichiometric phases stable only at high temperatures is related to a network of heterogeneous and homogeneous equilibria. A broad perspective of similarity and dissimilarity between the lanthanides and actinides emerges and forms the basis of the projected needs for further study.

17876 **Crystal structure of YD/sub 1.96/ and YH/sub 1.98/ by neutron diffraction.** Khatamian, D.; Kamitakahara, W.A.; Barnes, R.G.; Peterson, D.T. (Ames Laboratory-USDOE and Departments of Physics and Materials Sciences and Engineering, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Phys. Rev., B: Condens. Matter;* **21**: No. 6, 2622-2624(15 Mar 1980).

The crystal structure of YD/sub 1.96/ and YH/sub 1.98/ has been examined at room temperature and 11 K by neutron-diffraction techniques. Refinement of the data reveals the occupation of both tetrahedral and octahedral interstices of the fcc metal lattice. These results help to explain some features observed in the optical properties of YH/sub x/.

17877 **Hydrogen location in yttrium dihydride by means of NMR measurements.** Anderson, D.L.; Barnes, R.G.; Peterson, D.T.; Torgeson, D.R. (Ames Laboratory-USDOE and Departments of Physics and Materials Sciences and Engineering, Iowa State University, Ames, Iowa 50011). W-7405-ENG-81. *Phys. Rev., B: Condens. Matter;* **21**: No. 6, 2625-2626(15 Mar 1980).

The proton magnetic resonance rigid-lattice second moment in YH/sub 1.92/ and YH/sub 1.98/ has been measured in the temperature range 160—200 K. From these the occupancy factors for hydrogen in the octahedral and tetrahedral interstitial sites of the fcc metal lattice have been determined. A significant fraction (≅ 10—15 %) of the octahedral sites are found to be occupied, consistent with features observed in the optical properties of YH_2.

MECHANICAL PROPERTIES

17878 (CONF-791134—11) **Pressure and temperature behavior of framework silicates and nitrides.** Cartz, L.; Jorgensen, J.D. (Marquette Univ., Milwaukee, WI (USA). Dept. of Mechanical Engineering; Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

The response of silicates and nitrides to changes of pressure or of temperature depends on the flexibility of the bond angles of the crystal structures. Where bond angles can vary between neighboring tetrahedra linked at one corner, relative tilting or rotations occur which modify the three dimensional framework and this dominates the response of the crystal structure to temperature or pressure changes. Direct evidence for this behavior is available from measurements by time-of-flight neutron diffraction with multi-component profile refinement procedures, where atomic position changes have been determined to pressures of ~ 3 x 10^9Pa. The importance of the framework structural type was illustrated by studies of the flexible α-quartz structures of SiO_2 and GeO_2 which have volume compressibility coefficients K/sub v/ ~ 26 x $10^{-12}Pa^{-1}$, the partially flexible structures Si_2N_2O and Ge_2N_2O with K ~ 9 x $10^{-12}Pa^{-1}$, and the rigid structures α and β Si_3N_4 with k/sub v/ ~ 3 x $10^{-12}Pa^{-1}$.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 17875, 17878

17879 (CONF-7706168—, pp 13p, Paper B3) **Thermodynamic state and gas kinetic relaxation behavior of saturated UO_2 vapor up to temperatures of 5000°K.** Karow, H.U. (Karlsruhe Nuclear Reseach Center, Germany). 1977.

From Conference on materials for high temperature energy sources; Odeillo, France (27 Jun 1977).

The thermodynamic state, caloric equation-of-state, and the gas kinetic relaxation properties of saturated uranium dioxide fuel vapor in the temperature region far above 3000°K are discussed. The function of the internal energy, enthalpy, and specific heat have been determined by means of statistical mechanics. In derivation of these functions-of-state, the multicomponent molecular equilibrium composition of the saturated oxide fuel vapor has been taken into account. The contribution of the thermally excited electronic states of the vapor molecules has been derived by means of a Rydberg orbital model of the UO_2 molecule. The discussion of the thermodynamic state includes the evaluation of the plasma state and its contribution to the caloric variables-of-state. Because of the extremely high ion and electron density due to thermal ionization, the ionized component of the fuel vapor does no longer represent a perfect kinetic plasma - different from the nonionized neutral vapor component with perfect gas kinetic behavior up to about 5000°K. The relaxational properties and gas dynamic behavior of adiabatically expanding fuel vapor are discussed with the example of laser-generated UO_2 vapor jets.

17880 **Infrared spectra of hydrogen isotopes in α-Al_2O_3.** Engstrom, H.; Bates, J.B.; Wang, J.C.; Abraham, M.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1520-1526(15 Feb 1980).

Infrared absorption of OH^-, OD^-, and OT^- in α-Al_2O_3 at 77 K occurs at energies of 3282, 2439, and 2069 cm^{-1}, respectively. A small band at 3266 cm^{-1} disappeared after high-temperature treatment of the crystal and was attributed to an OH^- ion which is perturbed by an unidentified defect. Calculations of the electrostatic potential combined with measurements of the polarization of the absorbed light indicated that the OH^- ion lies in the basal plane of the crystal. No evidence was found from measurements of the EPR spectrum of a γ-irradiated crystal for the presence of V^-/sub OH/ centers in α-Al_2O_3.

17881 **Temperature dependence of fluorescence yield and lifetime of F^+ centers in SrO.** Jeffries, B.; Feldott, J.; Summers, G.P.; Chen, Y. (Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74074). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1537-1542(15 Feb 1980).

The excited states of the F^+ center in neutron- or proton-irradiated SrO have been studied by measuring the temperature dependence of the yield and lifetime of the F^+ fluorescence over the temperature range from 5 to 140 K. Both the fluorescence yield and lifetime decrease in two stages; one over the temperature range from 5 to 60 K, and the other over the range 60 to 140 K. The results are interpreted in terms of a three-level model of the F^+ center which is suggested by recent theoretical work. The lowest radiative level, which has a lifetime of 0.42 μsec, is found to be 0.05 eV below the conduction band. Another level is found only 0.005 eV above this radiative level. In order to account for the results, nonradiative decay to the ground state appears to occur from this second level.

COMPOSITE MATERIALS

PHYSICAL PROPERTIES

17882 **High-transition-temperature superconducting particles in an insulating matrix.** Tsuei, C.C.; Yeh, J.T.C. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). *AIP Conf. Proc.;* **58**: No. 1, 67-78(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

A number of new bulk granular superconductors consisting of high transition-temperature (T/sub co/) superconducting particles of V_3Si, NbN or $Mo_3Pb_1S_8$ embbeded in a variety of resins have been prepared. The resistive superconducting transition temperature T/sub c/ for these composite conductors is, in general, less than half of T/sub co/. In samples containing V_3Si powder (~20μm in average particle size), T/sub c/ as high as 7.5K has been achieved. The superconducting properties, electrical and magnetic, can be understood if these materials can be considered as 3-dimensional arrays of Josephson junctions. Potential applications for these bulk granular superconductors are discussed.

17883 **Far infrared absorption in granular superconductors.** Carr, G.L.; Garland, J.C.; Tanner, D.B. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). ER-S-02-4914. *AIP Conf. Proc.;* **58**: No. 1, 288-292(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

Measurements of far infrared transmission and reflection have been done on composites consisting of small tin particles (approximately 250A radius) embedded randomly in an insulating matrix of KCl, with volume fraction of tin ranging from 0.001 to 0.03. These experiments measure the optical properties from 3 cm^{-1} to 50 cm^{-1} and at temperatures from 1.7K to 27K, thus covering the energy gap frequency and the transition temperature of the tin. The results of these experiments show an enhanced absorption around the gap frequency at superconducting temperatures.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 17793

17884 2,5 dimethyl 2,5 hexane diamine: a promising new curing agent for epoxy resins. Rinde, J.A.; Chiu, I.; Mones, E.T.; Newey, H.A. (Univ. of California, Livermore). *SAMPE Q.;* **11**: No. 2, 22-31(Jan 1980).

A new curing agent for epoxy resins that has both interesting and useful properties was found. The compound, 2,5 dimethyl 2,5 hexane diamine (DMHDA) is a sterically hindered primary aliphatic amine that, as a curing agent for DGEBA epoxy resins, has the following desirable characteristics: at room temperature it forms a stable B-stage resin; it is a good wet-filament winding resin having a low viscosity (0.5 Pa.s) and a long gel time (21 h for a 30-g mass); the cured resin properties are good, for example, the tensile strength is 86 MPa (12,500 psi), and the glass transition temperature is greater than 140°C when cured at 130°C.

OTHER MATERIALS

17885 Conservation of energy, the environment and money by cogeneration in cement production. Green, L. Jr. (General Atomic Co., Washington, DC). pp 54-60 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The wet process for producing portland cement is uniquely well suited to the application of a coal-fired, closed-cycle gas turbine for the cogeneration of not only electric power and process heat but also process ingredients as well. This paper proposes a concept in which reject heat from the closed turbine cycle is used for partial dewatering of the feed slurry entering the kiln. The bottom ash and sulfate-contaminated limestone from a fluidized-bed combustor constitute feed materials for the cement process. The other combustion products (fly ash and hot gases) are fed directly to the kiln, which acts as a scrubber for them while utilizing their heat. The fuel utilization efficiency of this total energy system thus can exceed 90%. Since the system does not require high-quality, high-cost coal, and removes the dependence upon increasingly costly and sometimes unavailable purchased electricity, significant savings in the operational cost of the plant may be realized together with minimum environmental impact.

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 17489, 17490, 17491, 17492, 17493, 17494, 17495, 17499, 17503, 17504

17886 Silicon ribbon growth using scanned lasers. Baghdadi, A.; James Ellis, R.; Gurtler, R.W. (Motorola, Inc., Solar Energy RD Department, Phoenix, Arizona 85008). 954376. *Appl. Opt.;* **19**: No. 6, 909-913(15 Mar 1980).

The recent drive for low-cost photovoltaic arrays has renewed the interest in growing silicon in ribbon form. Our approach is to use a pair of scanned focused CO_2 laser beams to establish a molten zone in a preformed fine-grained polycrystalline ribbon. Large-grained macrocrystalline silicon is then drawn from the molten zone at high rates. The coupling of the 10.6-μm laser beam to the melt zone is very low due to the high reflectivity of molten silicon. However, the coupling can be greatly increased by using a spherical-section reflector to reimage the reflected beam onto the molten zone. Silicon ribbon has been grown at rates up to 13.3 cm/min by this method. The best solar cell fabricated so far on this material had a conversion efficiency of 12.7%.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 18191

17887 Carbon K-edge fine structure in graphite foils and in thin-film contaminants on metal surfaces. Denley, D.; Perfetti, P.; Williams, R.S.; Shirley, D.A.; Stoehr, J. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **21**: No. 6, 2267-2273(15 Mar 1980).

We report absorption and extended-fine-structure studies on the carbon K edge in microcrystalline, polycrystalline, and oriented crystalline (monochromator) graphite. On the basis of a density-of-states analysis, strong excitonic effects about the core hole are inferred. The fine structure at the absorption edge is found to differ for the three materials. This is explained by the orientational dependence of the polarization selection rules for electric dipole transitions from an s core to σ and π conduction-band states. The extended x-ray fine structure (EXAFS) above the edge exhibits similar oscillations for the bulk crystalline samples (polycrystalline and monochromator graphite), but considerably weaker structure is observed for the microcrystalline sample. A Fourier analysis of the oscillations yields the nearest-neighbor shell separations. Finally, it is shown that the intensity modulations caused by carbon contamination on optical Au and Pt mirror surfaces that are exposed to high-intensity synchrotron radiation closely resemble those above the C K edge in bulk crystalline graphite. This indicates the formation of graphitic overlayers on such mirrors even under ultrahigh-vacuum ($<1 \times 10^{-9}$ Torr) conditions. These findings furthermore demonstrate the feasibility of EXAFS studies of adsorbates on surfaces by monitoring the (totally) reflected radiation off the substrate.

17888 Electronic states and bonding configurations in hydrogenated amorphous silicon. Ching, W.Y.; Lam, D.J.; Lin, C.C. (Department of Physics, University of Missouri-Kansas City, Kansas City, Missouri 64110). *Phys. Rev., B: Condens. Matter;* **21**: No. 6, 2378-2387(15 Mar 1980).

A series of realistic structural models have been constructed for hydrogenated amorphous silicon (a-Si:H) with the hydrogen atoms appearing as SiH, SiH_2, SiH_3, $(SiH_2)_2$, SiHHSi (a broken Si—Si bond with two H atoms inserted), SiHSi (bridge form), an interstitial atom, and an atom at the center of a six-member ring (ring-center model) in an otherwise continuous-random-tetrahedral network of amorphous silicon. The electronic energie: for each structural model (with one H-bonding configuration) are calculated by using the first-principles method of linear combinations of atomic orbitals in which all the multicenter integrals in the Hamiltonian matrix elements are evaluated exactly. In the cases of the SiH, SiH_2, SiH_3, SiHHSi, and $(SiH_2)_2$ configurations, the calculated local densities of states of the valence band for the H atoms agree well with photoemission experiment, but a distinct discrepancy is found for the SiHSi bridge model and the ring-center model. The SiHHSi and $(SiH_2)_2$ models give gap states near the conduction-band edge, the occurrence of which is attributed to the interhydride interaction. The SiHHSi model is in good agreement with several sets of experiments and provides a simple mechanism for incorporating H atoms in amorphous Si to fairly high concentrations.

PROPERTIES

REFER ALSO TO CITATION(S) 17887, 17974

17889 Optical determination of smectic A layer spacing in freely suspended thin films. Rosenblatt, C.; Amer, N.M. (Applied Laser Spectroscopy Group, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Appl. Phys. Lett.;* **36**: No. 6, 432-434(15 Mar 1980).

Optical measurements of smectic A layer spacings in freely suspended thin films of three liquid crystals are reported. Although the measured spacings are close to those reported for the bulk, some anomalous behavior is noted. In addition, we report that the smectic A phase in the film can exist at unusually high temperatures.

17890 High pressure studies of luminescence efficiency and lifetime in La_2O_2S:Eu and Y_2O_2S:Eu. Webster, G.; Drickamer, H.G. (School of Chemical Sciences and Materials Research Laboratory, University of Illinois at Urbana—Champaign, Urbana, Illinois 61801). *J. Chem. Phys.;* **72**: No. 6, 3740-3747(15 Mar 1980).

The effect of pressure to 120 kbars has been measured on the luminescence efficiency of La_2O_2S:Eu and Y_2O_2S:Eu in concentrations from 0.1% to 3% europium. Lifetimes were also measured for the lanthanum compounds. For La_2O_2S:Eu the emissions from $^5D_0$ and $^5D_1$ decreased in intensity with increasing pressure; the very weak $^5D_2$ emission increased by a large factor, leveled in the region ~40—80 kbars and decreased at the highest pressure; the emission fro $^5D_2$ appeared at about 50—60 kbars and increased rapidly in intensity. These results could be explained essentially quantitatively in terms of the analyses of Struck and Fonger and the observed shift to higher energy of the charge transfer absorption. Increased concentration of dopant dampened the effect of pressure. This is also consistent with the analysis. In addition, the behavior of the lifetime with pressure confirmed the above results and showed that no significant new radiationless paths appear at high pressure. There were also large pressure effects in Y_2O_2S:Eu. While these differed quantitatively from the effects in La_2O_2S:Eu they could be explained in terms of the analysis and the difference in location of the charge transfer peak and its shift with pressure.

17891 Anomalous high-field electron injection and photoconduction in thin-film alkali halides. Pisanias, M.N.; Hamill, W.H. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *J. Appl. Phys.;* **51**: No. 3, 1569-1575(Mar 1980).

Transient ion currents in thin-film alkali halides at ca. <2 V, which may exceed 10^{-4} A cm^{-2} at 1 ms, decay rapidly according to Iproportionalt/sup -m/ with 0<m<1 and activation energies of ca.1 eV. At slightly higher applied voltages, e.g., 2.3 V for KI, there are well-defined thresholds for electronic conduction. The current rises slowly and may approach 0.1 A cm^{-2} within 1 s, depending on voltage and temperature. For oscilloscopic presentation the initial applied voltage is 3.5—6.0 V for KI and with appropriate external resistance the increasing electronic current sweeps the potential difference across the film downward. This procedure discloses other discrete conduction regimes at 3.8 and 2.4 V. The noise amplitude attains 20% of the mean value with a random frequency estimated at ~1 MHz. This current is attributed to field injection associated with a compact space charge at the cathode resulting from precursor defect ion drift in the disordered film. These thresholds have been confirmed by photoconductivity measurements of I versus hν in the 2—4-eV range by injection from the Al cathode. For KCl, KBr, KI, and RbI the thresholds for I versus V were verified and three injection modes were found altogether for each system.

17892 Optical properties of polycrystalline anthracene in the 3.2—9.3-eV spectral region. Painter, L.R.; Riedinger, T.S.; Birkhoff, R.D.; Heller, J.M. Jr. (The University of Tennessee, Department of Physics and Astronomy, Knoxville, Tennessee 37916). EY-76-S-05-3861. *J. Appl. Phys.;* **51**: No. 3, 1747-1750(Mar 1980).

The optical functions of polycrystalline anthracene films have been determined in the spectral region between 3.2 and 9.3 eV. Conventional reflectance techniques using the semicylinder method were used to obtain the optical and dielectric functions for our sublimed films. In general the maxima in our data occur at energies comparable to those where maxima occur in single-crystal data. However, the magnitudes are frequently quite different. Our data indicate that the a and b axes of the crystallites tend to lie in a plane parallel to the surface of the substrate.

17893 Calculation of structurally related properties of bulk and surface Si. Ihm, J.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1527-1536(15 Feb 1980).

The self-consistent pseudopotential method is applied to study the bulk and surface structurally related properties of Si. Equilibrium configurations are determined by minimizing the total energy of the system; the calculated bulk properties and the surface relaxation of Si are found to be in good agreement with experiment. The surface energy and the surface reconstruction of Si are briefly discussed.

17894 Condensed xenon at high pressure. Ross, M.; McMahan, A.K. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1658-1664(15 Feb 1980).

This paper presents calculations on xenon at high pressure. We have employed recent developments in electron-band theory and the theory of fluids to demonstrate that the experimental solid isotherm, liquid shock compression Hugoniot, and high-energy atomic-beam-scattering data are all consistent and in agreement with theoretical predictions. Electron-band theory predicts that xenon will transform from an insulator to a metal at a pressure in excess of 1.3 Mbar.

17895 Rare-earth magnetic isolation and superconductivity on the Chevrel-phase compounds. Jarlborg, T.; Freeman, A.J. (Physics Department and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev. Lett.;* **44**: No. 3, 178-182(21 Jan 1980).

Results of ab initio self-consistent linear muffin-tin orbital energy-band studies for $EuMo_6S_8$, $GdMo_6S_8$, $SnMo_6S_8$ and $SnMo_6Se_8$ including all electrons in all 15 atoms/unit cell are reported. The large charge transfer from both the Eu, Gd, and Sn sites and from the Mo sites to the chalcogens is shown to be the driving mechanism with which to explain their unusual magnetic and superconducting properties.

CHEMISTRY

REFER ALSO TO CITATION(S) 18288

17896 (LBL—9881(DRAFT)) **Software standards in chemistry. NRCC Proceedings No. 7.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 182p. (CONF-790779—(DRAFT)). Dep. NTIS, PC A09/MF A01.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

Goal of this conference was to discuss and recommend standards for machine-independent, modular, and well-documented software for use on the large minicomputers that are becoming available to chemists. This volume comprises edited summaries of the invited talks, final reports of the working groups, and reports generated by subcommittees of the working groups.

17897 (LBL—9882) **Computational methods for molecular structure determination: theory and technique. NRCC Proceedings No. 8.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 397p. (CONF-790892—). Dep. NTIS, PC A17/MF A01.

From Computational methods for molecular structural determination: theory and technique; Bloomington, IN, USA (13 Aug 1979).

Goal of this workshop was to provide an introduction to the use of state-of-the-art computer codes for the semi-empirical and ab initio computation of the electronic structure and geometry of small and large molecules. The workshop consisted of 15 lectures on the theoretical foundations of the codes, followed by laboratory sessions which utilized these codes.

ANALYTICAL AND SEPARATIONS CHEMISTRY

ACTIVATION AND NUCLEAR REACTION PROCEDURES

17898 Determination of the concentration of solutes in liquids by means of the (n,α) and (n,γ) reactions. Greger, G.U.; Schuegerl, K. (Technische Univ., Hanover, Germany). *Nucl. Technol.;* **47**: No. 1, 208-212(Jan 1980).

A new method has been developed that allows measurement of the concentration of solutes with polar groups in the bulk of suitable organic solvent phases as well as at the interface of this phase with an aqueous phase. The measuring method is based on the production of alpha particles and gamma rays by means of (n,α) and (n,γ) reactions in the liquid phase, in which boron or lithium compounds are solved. The alpha particles and gamma rays are detected by means of liquid scintillation. The separation of the pulses is carried out by means of pulse-shape analysis. This method can also be applied to the estimation of the interfacial area of liquid-liquid systems, since the intensity of the light emission of the scintillation solution is proportioned to the interfacial area.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 17921

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

17899 (CONF-800303—10) **Rapid separation of individual rare-earth elements from fission products.** Baker, J.D.; Gehrke, R.J.; Greenwood, R.C.; Meikrantz, D.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 12p. Dep. NTIS, PC A02/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

A microprocessor-controlled radiochemical separation system has been developed to rapidly separate rare-earth elements from gross fission products. The system is composed of two high performance liquid chromatography columns coupled in series by a stream-splitting injection valve. The first column separates the rare-earth group by extraction chromatography using dihexyldiethylcarbamylmethylenephosphonate (DHDECMP) adsorbed on Vydac C_8 resin. The second column isolates the individual rare-earth elements by cation exchange using Aminex A-9 resin with α-hydroxyisobutyric acid (α-HIBA) as the eluent. With this system, fission-product rare-earth isotopes with half-lives as short as three minutes have been studied.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 17424, 17501

17900 Laser-heated high-temperature EPR spectroscopy. Yager, T.A.; Kingery, W.D. (Ceramics Division, Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-S-02-2390. *Rev. Sci. Instrum.;* **51**: No. 4, 464-466(Apr 1980).

A CO_2 laser-heated sample holder for an EPR spectrometer capable of temperatures above 1200°C is described. Since only the sample is heated, this system permits rapid temperature changes and rotation of the magnet around the sample. The spectra of MgO containing Fe^{3+} and Cr^{3+} at room temperature and 1200°C are presented.

17901 Spectrophotometric determination of boric acid in boron powder with curcumin. Grotheer, E.W. (Bendix Kansas City Div., MO). Contract DE AC04-76-DP00613. *Anal. Chem.;* **51**: No. 14, 2402-2403(Dec 1979).

A rapid and accurate method was needed to determine trace amounts of boric acid for quality control and specification testing of elemental boron. The reaction between boric acid and curcumin occurs at a measurable rate only when the curcumin molecule is protonated. Protonation takes place at the carbonyl groups in the presence of a strong acid and occurs completely and rapidly when sulfuric acid is added to a solution of curcumin in acetic acid. Spectrophotometric measurements were made. The extraction of boric acid from boron powder was found to be complete within 2h when either water or the diol solution was used. Whatman No. 40 cr 42 filter paper was used to obtain diol samples free of boron particles. The extraction efficiency of 2-ethyl-1,3-hexanediol was evaluated by adding 1 ml of 500 ppM aqueous boric acid and 1 drop of 10% NaOH to accurately weighed samples of boron powder. The water then was evaporated at room temperature and the samples were extracted with diol solution. The data obtained are included. The extraction efficiency also was evaluated by determining the boric acid content of boron which had been recovered from a previous extraction and boric acid determination. The determination of boric acid using curcumin is unaffected by the presence of other compounds, except for fluoride and nitrate ions. 2 tables. (DP)

SEPARATION PROCEDURES

17902 Effects of pressure, temperature, adsorbent surface, and mobile phase composition on the supercritical fluid chromatographic fractionation of monodisperse polystyrenes. Conaway, J.E.; Graham, J.A.; Rogers, L.B. (Univ. of Georgia, Athens). Contract EY-76-S-09-0854. *J. Chromatogr. Sci.;* **16**: 102-110(Mar 1978).

No significant differences have been found in the separation behavior of oligomers of monodisperse polystyrene samples when using n-pentane as the mobile phase and a phenyl or an n-octadecyl bonded stationary phase. For low-molecular weight polystyrenes used in this study, there was no evidence of steric exclusion effects when using non-derivatized silica. In all cases, the addition of either isopropanol or cyclohexane as a moderator was found to produce more nearly complete elution of the polystyrene oligomers from the stationary phases. Concentrations of isopropanol above 5% v/v caused no further change while increasingly higher percentages of cyclohexane caused capacity ratios of higher molecular weight species to decrease. Finally, non-linear pressure programming was found to produce more nearly regular elution of an oligomeric series while linear downward temperature programming was found to produce irregular elution behavior near the critical temperature. 14 figures, 2 tables.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 17429

17903 Photoelectron spectroscopy of alkali halide vapors. Berkowitz, J. (Argonne National Lab., IL). pp 155-188 of Alkali halide vapors: structure, spectra, and reaction dynamics. New York, NY; Academic Press, Incorporated (1979).

The current status of knowledge regarding the photoelectron spectra of alkali halide vapors is reviewed. The study of photoelectron spectra has been extended to larger aggregates including a neutral dimer molecule of the form M_2X_2 where M = an alkali metal atom and X = a halogen, a dimer ion where the charge is removed from the halogen, or a dimer where the charge is removed from the metal ion. The experimental data from these studies on larger aggregates and on alkali metal halide crystals are compared with a relatively simple model. A brief summary of fragmentation processes subsequent to ionization is presented. 66 references. (BLM)

17904 Generalized transition state theory calculations for the reactions $D+H_2$ and $H+D_2$ using an accurate potential energy surface: Explanation of the kinetic isotope effect. Garrett, B.C.; Truhlar, D.G. (Chemical Dynamics Laboratory, Kolthoff and Smith Halls, Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *J. Chem. Phys.;* **72**: No. 6, 3460-3471(15 Mar 1980).

Rate constants are calculated for the reactions $D+H_2 \rightarrow DH+H$ and $H+D_2 \rightarrow HD+D$ and compared to measured values. An accurate potential energy surface, based on the ab initio calculations of Liu and Siegbahn, was used. Rates were calculated using both conventional transition state theory and canonical variational theory. In the former, the generalized transition state dividing surface is located at the saddle point; in the latter it is located to maximize the generalized free energy of activation. We show that, in the absence of tunneling corrections, locating the generalized-transition-state dividing surface variationally has an important quantitative effect on the predicted rate constants for these systems and that, when tunneling is included, most of the effect of using a better dividing surface can be included in conventional transition state theory for these systems by using a consistent transmission coefficient for quantal scattering by the vibrationally adiabatic potential energy curve. Tunneling effects are important for these reactions even for temperatures larger than 400 K. We show how to separate classical recrossing effects from quantal corrections on reaction-coordinate motion in both the transmission coefficients and the kinetic isotope effects. Our most complete calculations are in excellent agreement with most of the measured rate constants and kinetic isotope effects.

17905 MCSCF potential energy surface for the high barrier adiabatic $1\,^1\Sigma^-$ pathway of the $O^+(^4S)+N_2(X\,^1\Sigma/\text{sub g}/^+) \rightarrow NO^+(X\,^1\Sigma^+)+N(^4S)$ reaction. Hopper, D.G. (Theoretical Chemistry Group, JAYCOR, Dayton, Ohio 45431). *J. Chem. Phys.;* **72**: No. 6, 3679-3685(15 Mar 1980).

The collinear $^4\Sigma^-$ pathway for the state-specific $O^+(^4S)+N_2(X\,^1\Sigma/\text{sub g}/^+) \rightarrow NO^+(X\,^1\Sigma^+)+N(^4S)$ reaction has been surveyed with ab initio calculations. A ninety-nine configuration, fifteen orbital multiconfiguration self-consistent field (MCSCF) wave function, involving the use of a double-zeta plus polarization one-electron basis, was developed for the long range $^4\Sigma^-$ state. This long range $^4\Sigma^-$ state has the character of $O^+ + N_2$ for long R/sub NO/, or of $N+NO^+$ for long R/sub NN/, and is for most geometries, the lowest, or $1\,^4\Sigma^-$, state. The ab initio exothermicity computed with the present wave function is 0.93 eV, compared to an accurate experimental value of 1.10 eV. The saddle-point in the energy surface is 8.0 eV above $O^+ + N_2$, with critical values of R*/sub NN/ = 1.48 +- 0.02 A and R*/sub NO/ = 1.38 +- 0.02 A. These values are 0.38 and 0.32 A greater than the equilibrium bond lengths of $N_2(X\,^1\Sigma/\text{sub g}/^+)$ and $NO^+(X\,^1\Sigma^+)$. The present wave function reproduces the experimental bond lengths of these two diatomics to within 0.01 A when the third atom is removed to 500 a.u. (264.6 A). Preceding the barrier on the $O^+ + N_2$ side is an appreciable polarization well. With the present wave function the attributes of this well are $D^0(N_2—O^+)$ = 0.38 eV, R/sub NN//sup E/ = 1.108 A, R/sub NO//sup e/ = 2.350 A, θ/sup e//sub NNO/ = 180°, k/sup e//sub NN/ = 24.679 md/A, k/sup e//sub NO/ = 0.295 md/A, k/sub theta/ = 0.0366 md/A. There is also a smaller polarization well on the $N+NO^+$ side. Although the ion—atom interaction is more stable at C/sub s/ the latter well is bound by 0.02 eV at 180° with R/sup e// sub NN/ = 3.34 A, and R/sup e//sub NO/ = 1.07 A.

17906 B-halogenation of ammonia-borane: a nuclear magnetic resonance study. Hu, M.G.; Geanangel, R.A. (Univ. of Houston, Texas). *Inorg. Chem.;* **18**: No. 12, 3297-3301(Dec 1979).

Ammonia-borane and BX_3 (X = F, Cl, Br) were combined at low temperature in molar ratios from 3:1 to 1:2 with ether solvents. After warming and stirring of the mixtures at 25°C for 18 h, NMR samples were taken of each reaction mixture. The ^{11}B spectra of products from the $H_3N.BH_3$-BCl_3 reactions gave evidence for the new compounds $H_3N.BH_2Cl$ and $H_3N.BHCl_2$ along with $H_3N.BCl_3$, $(C_2H_5)_2O.BH_2Cl$, and $(C_2H_5)O.BHCl_2$. In the case of the BBr_3 reactions, products identified from their spectra include $H_3N.BH_2Br$, $(C_2H_5)_2O.BH_2Br$, and $(C_2H_5)_2O.BHBr_2$ along with ether cleavage products. A hydrogen-halogen exchange mechanism appeared to account satisfactorily for the products of the BCl_3 and BBr_3 reactions. The only major products from the $H_3N.BH_3$-BF_3 reactions were $H_3N.BF_3$ and $(\mu\text{-}H_2N)B_2H_5$. An acid displacement followed by a hydrogen elimination mechanism is proposed for the BF_3 reaction.

17907 Kinetic study of the oxidation of Vanadium(IV) by Americium(V). Woods, M.; Sullivan, J.C. (Argonne National Lab., IL). *Inorg. Chem.;* **18**: No. 12, 3317-3318(Dec 1979).

For the reaction Am(V) + 2V(IV) + 2V(IV) the empirical form of the rate law is $d[V(V)]/dt = k[Am(V)][V(IV)]$. At 25°C in 1.0 M perchloric acid the value of k = 4.58 +- 0.17 $M^{-1}\,s^{-1}$. The values calculated from the variation of k with temperature are $\Delta H^* = 12.7$ +- 0.3 kcal/mol and $\Delta S^* = -12.7$ +- 1 cal $deg^{-1}\,mol^{-1}$. Mechanistic considerations are presented for this reaction and the present results are compared to those of other oxidation studies of V(IV).

17908 Group 3A and 4A substituted AB_5 hydrides. Mendelsohn, M.; Gruen, D.; Dwight, A. (Argonne National Lab., IL). *Inorg. Chem.;* **18**: No. 12, 3343-3345(Dec 1979).

Crystallographic cell volume data are presented for a series of alloys LaNi/sub 5-x/M/sub x/(M = Al, Ga, In, Si, Ge, Sn) for x = 0 to 0.5. Pressure-composition desorption isotherms were measured for the hydrides of $LaNi_{4.6}Si_{0.4}$ and $LaNi_{4.6}Ge_{0.4}$ at 30, 40, and 60°C. From plots of ln P vs. 1/T the enthalpies and entropies of transition were calculated to be -8.5 kcal/mol of H_2 and -27.3 cal/(mol of H_2 deg) for $LaNi_{4.6}Si_{0.4}H$/sub y/ and -8.2 kcal/mol of H_2 and -26.5 cal/(mol of H_2 deg) for $LaNi_{4.6}Ge_{0.4}H$/sub y/. The thermodynamic quantities as well as the hysteresis behavior of these hydrides are compared to data previously obtained for the hydrides of $LaNi_{4.6}Al_{0.4}$, $LaNi_{4.6}Ga_{0.4}$, $LaNi_{4.6}In_{0.4}$, and $LaNi_{4.6}Sn_{0.4}$.

17909 Ohm's law, Fick's law, and diffusion samplers for gases. Palmes, E.D.; Lindenboom, R.H. (New York Univ., NY). *Anal. Chem.;* **51**: No. 14, 2400-2401(Dec 1979).

In the diffusion sampler, the coefficient of diffusion of a gas in air and the geometry of the tube were treated separately. The diffusional flux through the tube was calculated using JA = D(A/L)c and for electrical current through a conductor I = E/R where I = current (C/s), E = potential difference (V), and R = resistance (ohms). Resistance to diffusional flux was expressed as L/A. The similarities between Fick's law and Ohm's law were concentrated on; a series of NO_2 samplers were modified. The total resistance to diffusion of the two tubes in series (L^1/A^1) was calculated from the relationship: $(L^1/A^1 = L_1\text{-}L_2/A_1 + L_2/A_2)$ where L_1 and A_1 are length and cross-sectional area of tube 1, and L_2 and A_2 are length and cross-sectional area of tube 2. In all cases A_1 was 0.713 cm^2, L_1 was 7.10 cm, and A_2 was 0.079 cm^2. The quantities of NO_2 captured by the samplers in each of three runs were shown as percent of the amount captured by the unaltered (L_2=O) samplers. Actual quantities of NO_2 captured and relative diffusional fluxes predicted from tube dimensions are included. Linear regression analysis comparing experimental values with those predicted from A^1/L^1 gave the following results for runs 1, 2, 3, and average, respectively: slope 0.995, 1.007, 0.993, and 0.999; intercept -0.07, -1.59, 0.06, and -0.52; correlation 0.999 in all cases. Thus, the results fit the theory well within limits of accuracy of the test systems, and demonstrate that diffusional resistances in series, like electrical resistances, are additive. 1 figure, 1 table. (DP)

17910 Sulfur poisoning of nickel methanation catalysts. I. In situ deactivation by H_2S of nickel and nickel bimetallics. Bartholomew, C.H.; Weatherbee, G.D.; Jarvi, G.A. (Brigham Young Univ., Provo, Utah). *J. Catal.;* **60**: No. 2, 257-269(Nov 1979).

The effects of exposure to dilute H_2S during reaction on the methanation activity of alumina-supported nickel, cobalt, and nickel bimetallic catalysts in powder, pellet, and monolith form were investigated. Results of activity tests at 525°K, 1 atm, and a space velocity of 30,000 hr^{-1} with 10 ppM H_2S in the reactant stream show that cobalt and most nickel bimetallic catalysts are not significantly more or less sulfur tolerant than nickel; Ni-MoO_3, however, is more active before, during, and after exposure to H_2S. The data also indicate that monolithic catalysts are significantly more sulfur resistant than either powder or pellet catalysts. All of these catalysts, however, are completely deactivated within a period of 2 to 3 days under the conditions investigated. During reaction in the presence of H_2S, there is an exponential decrease in activity accompanied by a gradual breakthrough of the poison. Less sulfur is adsorbed on the catalyst during reaction than would be if equilibrium adsorption occurred. Data showing the roles of temperature, gas composition, and catalyst geometry in the poisoning process and the results of regeneration experiments are presented and discussed. 8 figures, 3 tables.

17911 Mutual diffusion coefficients of NaCl-H_2O and $CaCl_2$-H_2O at 25°C from Rayleigh interferometry. Rard, J.A.; Miller, D.G. (Univ. of California, Livermore). Contract W-7405-ENG-48. *J. Solution Chem.;* **8**: No. 10, 701-716(Oct 1979).

The volume-fixed mutual diffusion coefficients of NaCl-H_2O and $CaCl_2$-H_2O have been measured to an accuracy of 0.1 to 0.2%, from dilute solutions to high concentrations, by free diffusion Rayleigh interferometry. These diffusion coefficients are compared to other diffusion data for these salts, obtained from Gouy interferometry and the conductometric method. Discrepancies between data in the literature are resolved using the present results. Some diffusion coefficients have also been measured for KCl-H_2O and NH_4Cl-H_2O. 4 figures, 5 tables.

17912 Mutual diffusion coefficients of Na_2SO_4-H_2O and $MgSO_4$-H_2O at 25°C from Rayleigh interferometry. Rard, J.A.; Miller, D.G. (Univ. of California, Livermore). *J. Solution Chem.;* **8**: No. 10, 755-766(Oct 1979).

The volume-fixed mutual diffusion coefficients of Na_2SO_4-H_2O and $MgSO_4$-H_2O have been measured, from dilute solutions to near saturation, to an accuracy of 0.1 to 0.2% by free-diffusion Rayleigh interferometry. These results are compared to other available diffusion data for these salts. The diffusion coefficients of Na_2SO_4-H_2O and $MgSO_4$-H_2O decrease regularly with increasing concentration, while those of many other salts exhibit both a maximum and a minimum as a function of concentration. A few diffusion coefficients have also been measured for KCl-H_2O. 3 figures, 5 tables.

17913 One-dimensional partially oxidized tetracyanoplatinate metals: new results and summary. Williams, J.M.; Schultz, A.J. (Argonne National Lab., IL). pp 337-368 of Molecular metals. Hatfield, W.E. (ed.). New York, NY; Plenum Publishing Corporation (1979).

A review of the status of research dealing with the physical and chemical properties of partially oxidized tetracyanoplatinate (POTCP) complexes and their analogs of the type $K_2[Pt(CN)_4]Br_{0.3}\cdot 3H_2O$ is presented. The analog is designated as KCP(X) where X is Br^- or Cl^-. Preparations of the POTCP complexes are reviewed in some detail. Electrochemical techniques generally involving oxidation of Pt^{2+} salts with a 0.5 to 1.5V dc source using Pt electrodes usually results in the production of POTCP much more rapidly than by ordinary chemical preparation methods. Crystal and molecular structures of selected POTCP salts are discussed in order to illustrate the special relationships relating structure to some physical property such as electrical conductivity. Data are presented for the preparation, crystal data, and electrical conductivity of a series of compounds of the MCP(X) type where M is K^+, Rb^+, Cs^+, or $[C(NH_2)_3]^+$ and X is F^- of $(FHF)^-$. 48 references. (BLM)

17914 Phase diagram of the system Li_2CrO_4-K_2CrO_4. Karnowsky, M.M.; Clark, R.P.; Biefeld, R.M. (Sandia Labs., Albuquerque, NM). *J. Solid State Chem.;* **23**: 219-223(1978).

The Li_2CrO_4-K_2CrO_4 phase diagram was determined by using differential thermal analyses with confirmation by high-temperature x-ray diffraction. The outstanding features are the formation of a eutectic composition of ~ 22.5 mole% K_2CrO between Li_2CrO_4 and the double salt, δ-$Li_2CrO_4.K_2CrO_4$, at 390°C; the formation of a congruently melting double Li_2CrO_4 with three solid state allotropic forms, γ, δ, and ϵ, the d spacings and colors of which are given; and the formation of a eutectic composition at ~ 54 mole% K_2CrO_4 between α K_2CrO_4 and the double salt, γ-$Li_2CrO_4.K_2CrO_4$, at 525°C. 2 figures, 2 tables.

17915 Polarized electronic absorption spectra for potassium tetrabromoplatinate(II) dihydrate. Spectral effects of a platinum(IV) component. Peters, T.J.; Kroening, R.F.; Martin, D.S. Jr. *Inorg. Chem.;* **17**: No. 8, 2302-2307(1978).

Crystals of the metastable compound $K_2PtBr_4.2H_2O$ have an orthorhombic structure, space group Pbam, with a:b:c = 8.31 (2):13.73 (3):4.84 (1) A and Z = 2. The $PtBr_4^{2-}$ ions occupies a crytallographic site of C/sub 2h/ symmetry but retains essentially a D/sub 4h/ molecular symmetry with the z axis directed along c. The absorption spectra in the d reverse arrow d region were recorded for a, b, and c polarizations. Band maxima lie at 300 to 800 cm^{-1} higher energies than in anhydrous K_2PtBr_4. The ^{1}A/sub 2g/ reverse arrow ^{1}A/sub 1g/ transition, forbidden in z polarization, was not observed in polarization. Vibrational components were resolved in the ^{3}B/sub 1g/ shoulder and in the ^{1}A/sub 2g/ peak. Striking differences in intensities which occurred in the a and b polarization indicated that crystal effects were important in the vibronic excitation process. Red sections, in some crystals, were attributed to a dipole-allowed band, completely c polarized, for a mixed-valence electron-transfer transition involving a $PtBr_6^{2-}$ impurity defect. 6 figures, 3 tables.

17916 Dodecatungstophosphoric acid-21-water by neutron diffraction. Spirlet, M.R.; Busing, W.R. (Oak Ridge National Lab., TN). *Acta Crystallogr., Sect. B;* **34**: 907-910(1978).

$H_3PW_{12}O_{40}.21H_2O$, orthorhombic, Pcca, Z = 4, a = 20.788 (10), b = 13.086 (3), c = 18.879 (5) A [at 22°C, λ(Mo Kα) = 0.70926 A], D_o = 4.17, D/sub c/ = 4.21 g cm^{-3}. Keggin anions form a layer near y = 0. Each has 43m pseudosymmetry with the central P atom on a twofold axis x = 1/4, y = 0, at z = 0.44585 (8). A pseudo 4 axis makes an angle of 20.42 (3)° with the x direction. Eighteen water O atoms form a second layer with $0.32 \leq y \leq 0.68$, and three others penetrate into the anion region. 2 figures, 3 tables.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 17918, 17928

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

17917 Single-crystal neutron diffraction study (17 K) of the unusual Cr-D-Cr bond in $[(Ph_3P)_2N]^+[Cr_2(CO)_{10}(\mu\text{-}D)]^-$. Evidence for a four-site distribution of the bridging deuterium atom. Petersen, J.L.; Brown, R.K.; Williams, J.M.; McMullan, R.K. (West Virginia Univ., Morgantown). *Inorg. Chem.;* **18**: No. 12, 3493-3498(Dec 1979).

A low-temperature (17 +- 2°K) neutron diffraction study of $[(Ph_3P)_2N]^+[Cr_2(CO)_{10}(\mu\text{-}D)]^-$ has been carried out to examine the nature of the Cr-D-Cr bond in the monoanion. The nondeuterium atoms are located with high precision and there is no indication of a metal carbonyl structural disorder. Only one peak is resolved for the bridging D atom, at the midpoint of the Cr-Cr line located on a crystallographic center of symmetry. The D atom's root-mean-square thermal displacements are several times larger than those for the remaining atoms and reflect a disordered structure for the D atom within the plane normal to the Cr-Cr line. Assuming equal population of four off-axis disordered D sites, a least-squares refinement demonstrates that the data accommodate this disordered model. Due to the close proximity of these disordered sites and the relatively large zero-point energy of the μ-D atom, the averaging nature of the diffraction experiment provides only a composite picture of the disordered structure in this case. Consequently, our interpretation is limited by the inherent limitations associated with diffraction methods and points out the need for further solid-state spectroscopic studies to obtain more detailed information about the

nature of this unusual disorder. The neutron-determined lattice parameters for the monoclinic cell, C2/c, are a = 21.148 (7) A, b = 16.004 (7) A, c = 15.819 (8) A, and β = 127.77 (4)° for λ 1.1602 (1) A. The agreements obtained for the two refinement models of the μ-D atom are identical. The final discrepancy indices for the fourfold disordered model are $R(F_o)$ = 0.0377, $R(F_o^2)$ = 0.0398, R/sub w/ (F_o^2) = 0.0518, and σ_1 = 1.21 for 4191 reflections with $F_o^2 > \sigma(F_o^2)$. The corresponding Cr-D-Cr bond angles and Cr-D bond distances agree with those determined from an earlier room-temperature study of $[Et_4N]^+$-$[Cr_2(CO)_{10}(\mu\text{-}H)]^-$, in which the twofold disordered structure for the bridging atom was resolved.

17918 Radioisotope labeling technique for vapor density measurements of volatile inorganic species. Peterson, E.J.; Caird, J.A.; Hessler, J.P.; Hoekstra, H.R.; Williams, C.W. (Argonne National Lab., IL). *J. Phys. Chem.;* **83**: No. 19, 2458-2462(20 Sep 1979).

A new method for complexed metal ion vapor density measurement involving labeling the metal ions of interest with a radioactive isotope is described. The isotope chosen in the present work is unstable and leads to emission of a characteristic γ ray. Thus the γ-counting rate was related to the number density of complexed metal ions in the vapor phase. This technique is applicable to the study of any volatile inorganic species, but in the present study has been used to measure vapor densities of complex species in the $TbCl_3$-$AlCl_3$ system by using tracer ^{160}Tb. 4 figures, 2 tables.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 17902

17919 (ISM—244) **Local aromatic properties of benzenoid hydrocarbons.** Randic, M. (Iowa State Univ. of Science and Technology, Ames (USA)). 1979. Contract W-7405-ENG-82. 10p. (CONF-7909123—1). Dep. NTIS, PC A02/MF A01.

From International symposium on aromaticity; Dubrovnik, Yugoslavia (3 Sep 1979).

Individual benzene rings in polycyclic benzenoid hydrocarbons are examined from a graph theoretical position in an effort to characterize structural features responsible for variations in local molecular properties. The basis for the present study is the concept of conjugated circuits (M. Randic, Chem. Phys. Lett. 38, 68 (1976)). By enumeration of conjugated circuits that encompass individual rings, local diversities in conjugation can be studied quantitatively. The approach defines for each ring in polycyclic conjugated hydrocarbons a code, a sequence of integers which indicate the occurrence of conjugated circuits of size (4n + 2) for a ring. Ring codes thus derived offer an alternative partitioning of the molecular resonance energies. The average ring resonance energy appears to be a good index of the aromatic character for benzenoid systems. The use of the ring codes is further illustrated on a re-examination of ring currents, where regularities in the relative magnitudes, not previously recognized, are indicated.

17920 Synthesis of some tetrahydrochrysenes as potential ultraviolet laser. Lyle, T.A.; Daub, G.H. (Univ. of New Mexico, Albuquerque). *J. Org. Chem.;* **44**: No. 26, 4933-4938(21 Dec 1979).

A general synthetic pathway employed in the synthesis of 5,6,11,12-tetrahydrochrysene and six of its benzo- and phenyl-substituted derivatives is described. Development of an efficient synthesis of the required starting materials 2-(3-biphenylyl)ethyl bromide and 6-phenyl-3,4-dihydro-1(2H)-naphthalenone is also presented. Preliminary laser performance data of the tetrahydrochrysenes have been included. 4 tables.

17921 Micro-hydrogenation unit. Gordon, B.E.; Brassel, S.; Kobayashi, S. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Anal. Chem.;* **51**: No. 14, 2407-2408(Dec 1979).

During research on the fate of accelerated carbon-14 ions and excited tritium atoms impinging on solid organic targets the need for a micro-hydrogenator capable of working with 10 ng- 10 mg of volatile materials in 100 μm of solvent became apparent. The hydrogenation system had to be applicable both to reinjection of fractions isolated from a gas chromatograph and up to 50 to 100 μL quantities of samples prepared for further analysis and workup. A diagram of the apparatus is included. Catalyst is added to the vial by dipping a piece of thin walled glass tubing, 1-mm i.d., into the bottle of catalyst so that about a 3 to 5 mm high plug is collected. This weighs approximately 1.5 mg and is blown into the vial. The sample solution is added (50 to 100 μL volume) and immediately fastened to the cap-cum-needle assembly and frozen with liquid nitrogen. The system is then alternately evacuated and filled with hydrogen to 30 psi three times to remove air. The vial is thawed, placed next to the rubble cone of a vortex mixer and agitated just enough to keep the catalyst suspended. After hydrogenation, the sample is again frozen, evacuated, and the vial unscrewed from the cap. A Mini-Inert valve cap for this size is screwed on, and the sample allowed to thaw. Samples can be withdrawn via a hypodermic for injection into a gas chromatograph. Three hydrogenations of cyclohexene in cyclohexane (1:1 μL) were performed with this system to test the completeness of reaction and sample loss. The sample weight losses ranged from 2.9 to 3.7%; the product cyclohexane was 99.7% pure. 1 figure. (DP)

17922 Refinement of the crystal structure of putrescine diphosphate with neutron diffraction data. Takusagawa, F.; Koetzle, T.F. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. B;* **34**: 1910-1915(1978).

The crystal structure of putrescine diphosphate, $[NH_3(CH_2)_4NH_3]^{2+}.2[H_2PO_4]^-$, has been refined, based upon neutron diffraction data measured at 85°K. Crystal data: space group $P2_1/a$; a = 7.890 (7), b = 9.725 (8), c = 8.132 (8) A, β = 110.26 (5)°, Z = 2. The final unweighted R value based on F^2 is 0.038 for 1691 unique reflections, and all bond distances have been determined with precision better than 0.002 A. The amino groups on putrescine are protonated, and each is hydrogen bonded to three neighboring phosphate groups. The ammonium and phosphate groups are both roughly tetrahedral; however, small differences are observed in these groups between chemically equivalent covalent bond distances and angles. These differences may be ascribed to effects of hydrogen bonding and non-bonded contacts. The N and P coherent neutron scattering amplitudes have been refined to yield values of 0.927 (3) and 0.503 (3) x 10^{-12} cm respectively. 4 figures, 5 tables.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 17928

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 17927

17923 Coulombic effects in the quenching of photoexcited tris(2,2'-bipyridine)ruthenium(II) and related complexes by methyl viologen. Gaines, G.L. Jr. (General Electric Co., Schenectady, NY). Contract EG-77-C-02-4395. *J. Phys. Chem.;* **83**: No. 24, 3088-3091(29 Nov 1979).

Both intensity and lifetime measurements have been used to study the quenching of luminescence of several ruthenium(II)-bipyridyl complexes by methyl viologen (1,1'-dimethyl-4,4'-bipyridinium chloride) in aqueous salt solutions. For the neutral complex $(Ru(bpy)_2(CN)_2)^0$, no salt effect is observed and the quenching rate constant is near the diffusion-controlled limit. Another neutral complex, $(Ru(bpy)_2(bpy(COO^-)_2))^0$,exhibits a small negative salt effect, perhaps due to its highly dipolar structure. The three positively charged complexes studied, $(Ru(bpy)_3)^{2+}$, $(Ru(bpy)_2(bpy(CH_3)_2))^{2+}$, and $(Ru(bpy)_2(bpy(COOH)_2))^{2+}$, are all quenched with similar rate constants and show similar large positive salt effects; k/sub q/ increases approximately sixfold when [NaCl] is increased from 0.03 to 1.5 M, and at the highest salt content is within a factor of 2 of the diffusion-controlled limit. While the results are qualitatively consistent with the conventional Bronsted-Debye treatment of ionic reaction rates, large specific ion effects are indicated by limited data with $NaClO_4$ as a neutral salt.

17924 Production of singlet molecular oxygen from the oxygen quenching of the lowest excited singlet state of aromatic molecules in n-hexane solution. Wu, K.C.; Trozzolo, A.M. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 24, 3180-3183(29 Nov 1979).

The quantum yield of sensitized photoperoxidation of 2,5-dimethylfuran in oxygen-saturated n-hexane solution has been measured. The sensitizers used were 9-methylanthracene, 9-phenylanthracene, 9,10-dimethylanthracene, 9,10-diphenylanthracene, perylene, pyrene, 1,6-diphenylhexatriene, and rubrene, and the sensitized oxidation quantum yields were found to be 0.97, 1.09, 1.14, 1.20, 1.27, 0.79, 1.02, and 1.20, respectively. The experimental results indicate that singlet molecular oxygen can be produced directly from the oxygen quenching of the lowest excited singlet state of many aromatic molecules, i.e., the process $S_1 + {}^3O_2 \rightarrow T_1 + {}^1O_2$ is not negligible when compared to $S_1 + {}^3O_2 \rightarrow T_1 + {}^3O_2$. This shows that the former process must also be taken into consideration in the general treatment of oxygen quenching of the fluorescence from aromatic molecules.

17925 Photochemistry and photooxidation of tetraphenyl-p-dioxin. George, M.V.; Kumar, C.V.; Scaiano, J.C. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 19, 2452-2455(20 Sep 1979).

Laser flash photolysis studies of tetraphenyl-p-dioxin have led to the characterization of its triplet state. The T-T absorption spectra shows maxima at 350 and 545 nm; the triplet has a lifetime of 535 ns in methanol and can be quenched by di-tert-butyl nitroxide, paraquat dications, oxygen, and di-tert-butyl selenoketone. The interaction of the triplet with oxygen leads to the formation of singlet oxygen which in turn reacts with the title compound to yield benzil.

17926 Importance of intermolecular biradical reactions in polymer photochemistry. Poly(phenyl vinyl ketone). Small, R.D. Jr.; Scaiano, J.C. (Univ. of Notre Dame, IN). *Macromolecules;* **11**: 840-841(Jul 1978).

The role of biradicals in the initiation of polymerization has been reported. The results of a series of biradical trapping experiments are presented herein. These experiments were carried out to demonstrate the necessity of regarding the biradicals generated in the photodegradation of polymers as highly reactive species, capable of undergoing intermolecular reactions. Three different approaches used to examine the intermolecular activity were: laser photolysis, quantum yield studies, and initiation of polymerization. The results of the studies suggest that the reaction of biradicals in polymers are somewhat slower than in small molecules. (BLM)

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 17926

17927 (DOE/ER/03569—T1) **Gas phase radiolysis and vacuum ultraviolet photolysis of heterocyclic organic compounds. Progress report, Feburary 1, 1979-February 1, 1980.** Scala, A.A.; Nguyen, D.; Rourke, W.; Caputo, M. (Worcester Polytechnic Inst., MA (USA)). 1980. Contract AC02-76ER03569. 17p. Dep. NTIS, PC A02/MF A01.

The long-range objective of our research group is to gain a better understanding of the processes by which complex organic molecules react when they absorb large amounts of energy. This progress report describes the results of our recent work in three areas: diradicals derived from heterocyclic compounds; trimethylene diradicals from various sources; and ion-molecule reactions.

17928 Carbon-13 CIDNP from reactions of some simple organic and inorganic radicals during pulse radiolysis. Lawler, R.G.; Nelson, D.J.; Trifunac, A.D. (Argonne National Lab., IL). *J. Phys. Chem.;* **83**: No. 26, 3444-3448(27 Dec 1979).

Examples of carbon-13 NMR spectra exhibiting chemically induced dynamic nuclear polarization (CIDNP) during pulse radiolysis of aqueous solutions of simple organic and inorganic compounds in D_2O are presented. The following aspects of carbon-13 CIDNP are illustrated: (A) detection of CIDNP in a reaction where all protons have been replaced by deuterons, (B) generation of a theoretically ideal radical pair with only one I = 1/2 nucleus, and (C) use of isotopic enrichment to distinguish two different polarization pathways, and (D) comparison of proton and carbon-13 CIDNP from the same sample. The chemical systems studied include the radiolysis of CD_3OD in D_2O (D. and $.CD_2OD$ radicals) and the radiolysis of sodium formate in D_2O (CO_2^-.radical), sodium carbonate (CO_3^-.), and sodium chloroacetate ($.CH_2COO^-$).

17929 Electron transfer reactions involving acridine and related compounds. Neta, P. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 24, 3096-3101(29 Nov 1979).

Acridine is rapidly reduced by e/sub sol/$^-$ ($k = 3 \times 10^{10}$ M^{-1} s^{-1}) and by $(CH_3)_2CO^-$ ($k = 3 \times 10^9$ M^{-1} s^{-1} in water and 1.4×10^9 M^{-1} s^{-1} in i-PrOH). Reduction by $(CH_3)_2COH$ and CO_2^- is rapid and efficient only when the acridine is protonated (pK/sub a/ = 5.6). With neutral acridine, however, the slow reduction is accompanied by addition of these radicals to acridine. Both forms of acridine are reduced by pyridinyl radicals, although the acid more rapidly than the neutral form. In all these one-electron reductions the anion radical of acridine is produced, which in aqueous and alcoholic solutions undergoes rapid protonation on the nitrogen to form a neutral radical, with a pK/sub a/ apparently above 14. Related heterocyclic compounds, such as 1,10-phenanthroline and phenazine, behave in a similar fashion. The radicals produced by reduction of acridine and other heterocycles can transfer an electron to 9,10-anthraquinone in nonaqueous media or to anthraquinonesulfonate in aqueous solutions ($k \sim 10^9$ M^{-1} s^{-1}). The spectra of the resulting semiquinone radicals were found, in all cases examined, to be identical with those obtained by direct reduction of the quinone under similar conditions without the intermediacy of the heterocycle. This is in contrast with previous findings with a porphyrin-anthraqinone system. It is concluded that, despite the previous suggestion that an intermediate complex is formed upon electron transfer from tetraphenylporphyrin radical to anthraquinone, no such complex appears to be formed in the electron transfer reactions involving acridine and related heterocycles.

17930 Oxidation of Methoxyhydroxycyclohexadienyl radicals by quinones. The influence of the isomeric structure of the radical on the rate constant for electron transfer. Steenken, S.; Raghavan, N.V. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **83**: No. 24, 3101-3107(29 Nov 1979).

o-, m-, and p-Methoxyhydroxycyclohexadienyl radicals, produced in aqueous solution by the reaction of OH with anisole, react with p-benzoquinone by electron transfer with rate constants of 1.2 x 10^9, $\leqq 8 \times 10^5$, and 4.4×10^9 M^{-1} s^{-1}, respectively, to yield p-benzosemiquinone and o-, m-, and p-hydroxyanisole. The lifetime of intermediate carbocations produced by oxidation of the methoxyhydroxycyclohexadienyl radicals is $\leqq 1 \times 10^{-6}$ s and the production of the hydroxyanisoles occurs synchronously with the reduction of p-benzoquinone. Substitution of H by methyl in p-benzoquinone leads to a decrease in the rate constants for oxidation of the methoxyhydroxycyclohexadienyl radicals. This decrease, which reflects the decrease in the redox potential of the quinone, is much stronger for the ortho isomer than for the para isomer. The distribution of isomeric methoxyhydroxycyclohexadienyl radicals, as determined by analysis of the build-up kinetics of different benzosemiquinones, is equal with that of isomeric hydroxyanisoles formed as final products from the cyclohexadienyl radicals by oxidation.

17931 Kinetics of radical decay in crystalline amino acids. 7. Monohydrates. Tria, J.J.; Hoel, D.; Johnsen, R.H. (Florida State Univ., Tallahassee). *J. Phys. Chem.;* **83**: No. 24, 3174-3179(29 Nov 1979).

The kinetics of radical decay in x-irradiated single crystals of L-arginine hydrochloride monohydrate, L-asparagine monohydrate, and L-histidine hydrochloride monohydrate have been studied. At temperatures sufficiently low that no measurable dehydration occurs, radical decay fits a model which includes distinct activation energies for the combination of nearby radicals and for diffusion of distant radicals to within a critical reaction distance. At temperatures sufficiently high that significant dehydration occurs on the time scale of radical decay, two types of behavior were observed. In L-asparagine monohydrate and L-histidine hydrochloride monohydrate, radical decay became rapid only upon completion of dehydration, whereas in L-arginine hydrochloride monohydrate radical decay became rapid at the start of dehydration and was completed well before dehydration was complete. At intermediate temperatures the radical decay kinetics appear to be a combination of the diffusion-controlled process and the dehydration-assisted one. No radical conversions were observed during decay.

17932 ^{13}N species formed by proton irradiation of water. Tilbury, R.S.; Dahl, J.R. (Memorial Sloan-Kettering Cancer Center, New York, NY). Contract EE-77-S-02-4268. *Radiat. Res.;* **79**: No. 1, 22-33(Jul 1979).

We have shown that the irradiation of aerated water with 14.5-MeV protons produces as principal radioactive products nitrogen-13-labeled nitrate, nitrite, and ammonium ions. The yield of $^{13}NH_4^+$ varied from approximately 40% at low integrated dose (0.01 μAh) to 0.4% at high integrated dose (25 μAh), $^{13}NO_3^-$ varied from 50% at low dose to 85% at high dose. $^{13}N_2^-$ varied from 10% at low dose to 5% at high dose and 40% at intermediate doses. The results varied with recent use of target chamber. Induced radioactivity in the window foil was shown to have an effect on product composition. The effect of dissolved oxygen and certain additives (ethanol, ascorbic acid, formic acid, and ammonia) were investigated. In the absence of dissolved oxygen, or in the presence of ethanol, formic acid or ascorbic acid, almost pure $^{13}NH_3$ could be produced at doses up to 2μAh. The data are explained by postulating the initial production of $^{13}NH_3$ by successive abstraction of H atoms by the $^{13}NH_3$ to HNO_2 and HNO_3.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 17907

17933 (DP-MS—79-93) **Covalency of Neptunium(IV) organometallics from ^{237}Np Moessbauer spectra.** Karraker, D.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract EY-76-C-09-0001. 29p. (CONF-800303—8). Dep. NTIS, PC A03/MF A01.

From 179. national meeting of the American Chemical Society; Houston, TX, USA (23 Mar 1980).

The isomer shifts in ^{237}Np Moessbauer spectra arise from the shielding of neptunium's 6s orbitals by the inner 5f orbitals. In covalent bonding, ligand contributions to the 5f electron density increase the shielding, and the ^{237}Np isomer shift reflects differences in bond character among covalently bonded ligands. The large difference in isomer shift (3.8 cm/sec) between ionic Np(IV) and Np(III) compounds permits a good determination of ligand bonding differences in Np(IV) organometallic compounds. The Moessbauer spectra for about 20 Np(IV) organometallic compounds, principally cyclopentadienyl (Cp) compounds of the general composition Cp/sub x/Np chi/sub 4-x/ (x = 1,2,3; chi = Cl, BH_4, /sup n/Bu, Ph, OR, acac), show both the differences in σ bonding among the chi ligands, as well as the covalent effect of the Cp ligands.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

17934 (COO—2944-4) **Direct determination of atom and radical concentrations in thermal reactions of hydrocarbons and other gases. Progress report, January 1-December 31, 1979.** Skinner, G.B.; Chiang, C.C.; Krishna, P.M.M.; Wood, D.R. (Wright State Univ., Dayton, OH (USA)). Jan 1980. Contract EY-76-S-02-2944. 10p. Dep. NTIS, PC A02/MF A01.

This is the fourth annual progress report on this project. During the period covered by the first three reports (June 1976 through December 1978) a shock tube and an optical system to measure H and D atom concentrations were built and fully characterized. The performance of our microwave discharge lamps was defined by numerous high-resolution spectroscopic profiles, while empirical calibrations were made using mixtures of D_2-N_2O-Ar and hexamethylethane-Ar. H and D atom concentrations were measured in H_2-O_2-Ar, D_2-O_2-Ar, CD_4-Ar, CD_4-O_2-Ar and C_3H_8-Ar mixtures, and absorption measurements made for O_2-Ar mixtures. Several calculations of elementary rate constants were made, based on the above data. During 1979 H and D atom measurements were extended to C_3H_8-O_2-Ar, C_3D_8-Ar, C_3D_8-O_2-Ar, C_2H_6-Ar, C_2H_6-O_2-Ar, C_2D_6-Ar and C_2D_6-O_2-Ar mixtures. Most of these data have been interpreted in terms of elementary reactions, and several calculations of elementary reaction rate constants have been made. Our apparatus has been modified so concentrations of O, OH and other species besides H and D can be determined by absorption spectroscopy and measurements with our new system are being made. Two papers based on this work were published in 1979, and three presentations were made at scientific meetings.

17935 **Nitric oxide measurements in a flame by laser fluorescence.** Grieser, D.R.; Barnes, R.H. (Battelle Columbus Laboratories, Columbus, Ohio 43201). W-7405-ENG-92. *Appl. Opt.;* **19**: No. 5, 741-743(1 Mar 1980).

Laser fluorescence measurements have been performed to detect nitric oxide in a CH_4—O_2—N_2 flame at atmospheric pressure. For these measurements a frequency-doubled tunable dye laser was used to excite the UV γ-bands of nitric oxide. Sensitivities were adequate to detect naturally occurring levels of nitric oxide that were in the 20—30-ppm range. Higher sensitivities can be achieved using other currently available lasers having greater output intensities.

ENGINEERING

17936 (CONF-790742—) **Contracting seminar - engineering services to federal agencies - of the National Society of Professional Engineers annual meeting.** (National Society of Professional Engineers, Washington, DC (USA)). Dec 1979. 68p. Dep. NTIS, PC A04/MF A01.

From NSPE energy seminar; Knoxville, TN, USA (8 Jul 1979).

The seminar discusses the government-private sector engineering team for accomplishing engineering for the government. The challenge of engineers for the 1980s focuses on energy. Approach in accomplishing engineering is different for different agencies. How the Corps of Engineers, TVA, and DOE team together with the private sector to accomplish engineering is discussed. Representatives from these organizations made presentations, and then principals from three firms discussed how they work as part of the government team and how they manage the work. They discussed the requirements they must meet and the hurdles they must overcome in working for the government. A question-and-answer period followed.

GENERAL ENGINEERING

17937 (SAND—79-1651) **Drawing Control System report.** Shumway, K.J.; Esch, G.L. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 32p. Dep. NTIS, PC A03/MF A01.

The Drawing Control System (DCS) is described which is a computer-based network for releasing, distributing, and accounting for drawings at Sandia Laboratories in Albuquerque. The System utilizes the resources of the Univac 1108 and the attached teleprocessing equipment. The hardware, computer prorams, terminal dialogs, and files are discussed. The project management techniques used to control and carry out this Sandia project are also described. 17 figures, 1 table.

17938 **Reprocessing of nonoptimally exposed holograms.** Phipps, G.S.; Robertson, C.E.; Tamashiro, F.M. (Sandia Laboratories, Photometries Division, Albuquerque, New Mexico 87185). *Appl. Opt.;* **19**: No. 5, 802-811(1 Mar 1980).

Two reprocessing techniques have been investigated that are capable of correcting the effects of nonoptimum optical density of photographic amplitude holograms recorded on Agfa-Gevaert type 10E75 plates. In some cases a reprocessed hologram will exhibit a diffraction efficiency even higher than that obtainable from a hologram exposed and processed to the optimum density. The SNR of the reprocessed holograms is much higher than that of the same holograms belached with cupric bromide. In some cases the SNR approaches the optimum value for a properly exposed amplitude hologram. Subjective image quality and resolution of reprocessed hologram reconstructins appear to be no different than for normal single-development holograms. Repeated reprocessing is feasible and in some cases desirable as a means of increasing diffraction efficiency.

FACILITIES AND EQUIPMENT

17939 (DOE/CS—0147) **Classification and evaluation of electric motors and pumps.** (Argonne National Lab., IL (USA); Little (Arthur D.), Inc., Cambridge, MA (USA)). Feb 1980. Contract W-31-109-ENG-38. 251p. Dep. NTIS, PC A12/MF A01.

This study was mandated under Title IV, Part 3 of the National Energy Conservation Policy Act (NECPA). This classification and evaluation of electric motors and pumps represents a comprehensive study of their use in the industrial, transportation, commercial, agricultural, and municipal sectors of the US economy. The range of electric motors included all ac and dc integral and fractional hp units equalling or exceeding 1/6 hp. However, units of less than 1/6 hp and those in use in other than the previously defined sectors were summarily treated to ensure completeness. Pump equipment covered included the wide range of fluid-handling equipment powered by all energy forms. The range of sizes analyzed correlated with those for motors, roughly 1/6 to 20,000 shaft hp. An analysis task called for developing scenarios for the policy options stated in NECPA, based on labeling and standards, evaluating barriers to their implementation, and then evaluating probable results. 72 references, 65 figures, 78 tables.

17940 (SAND—79-1800) **Parachute/flotation bag recovery system for a large RV nose cone.** Pepper, W.M. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

This report describes the design and development of a single-stage recovery system consisting of a 6-ft dia guide surface parachute with a 3.5 ft^3 ram-air-filled flotation bag for ocean recovery of a 120-lb nose cone. Recovery procedures start with jettisoning a portion of the initial reentry mass before deploying the parachute.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 18273

17941 **Superconducting properties of in situ—processed Nb_3/Sn-Cu composites.** Finnemore, D.K.; Ostenson, J.E.; Verhoeven, J.D.; Gibson, E.D. (Ames Laboratory-USDOE, Department of Physics and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *J. Appl. Phys.;* **51**: No. 3, 1714-1718(Mar 1980).

Performance characteristics for a family of Nb_3Sn-Cu superconducting composites have been studied to determine the optimum value of various fabrication variables such as the Cu-to-Nb ratio, Sn content, reaction temperature, reaction time, and dendrite size in the original casting. Basic superconducting properties such as the critical current and effective upper critical field are found to change in a very regular way as these parameters change and there are clear design tradeoffs which can be made depending on the wire specifications needed. A typical high-performance wire is made from a $Cu_{70}Nb_{30}$ casting with 2—8-μm dendrite size reacted with a stoichiometric amount of Sn at 550 °C for 6 days. In this study there has been a special emphasis on materials made from casting of a Cu—20 wt% Nb dendritic alloy. Critical currents of this alloy are smaller than for the 30% Nb samples, but the wire can withstand about 3% bending strain at the outer surface of the wire with only modest degradation of the J/sub c/ values.

HANDLING EQUIPMENT AND PROCEDURES

17942 (SRO—0001-T1) **Hood and glove box standards, all projects. Specification No. 7187.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA)). Jun 1978. Contract EY-76-C-09-0001. 200p. Dep. NTIS, PC A09/MF A01.

Specifications coverings the types, arrangements, and details of gloveboxes, hood enclosures, and components considered stand-

ard at the Savannah River Plant and Savannah River Laboratory are presented. Subjects covered include safety, design, fabrication, materials of construction, testing, and services. Improved designs of gloveboxes and hoods are offered with standardized components consistent with reduced cost and improved safety. An appendix includes a typical procurement specification, arrangement drawings, and details for this equipments.

SHIPPING CONTAINERS

17943 (LA—8121-MS) **CRASHC: a two-dimensional code to compute the response of axisymmetric shipping containers to end-on impacts.** Butler, T.A.; Endebrock, E.G.; Payne, J.B. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 46p. Dep. NTIS, PC A03/MF A01.

Safety evaluation of radioactive material shipping containers entails determining their response to severe impact conditions. In this paper a computer code for obtaining the nonlinear response of axisymmetric shipping containers to end-on impact is described. The nonlinear equations of motion are derived with the finite element method. Large displacements and nonlinear strain and material properties are considered. The resulting computer code, CRASHC, is then used to simulate several impact tests. Results from these analyses indicate that the code can be successfully used for simulating these impact conditions. Based on the simulations, several recommendations are made for improving these kinds of analyses and for interpreting the results.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 17383

LASERS

REFER ALSO TO CITATION(S) 18280

17944 (DOE/ER/70004—259) **X-ray laser pumping with enhanced radiation from electron storage rings.** Csonka, P.L. (Oregon Univ., Eugene (USA)). 1978. Contract EY-76-S-06-2230-004. 23p. (RLO—2230-T4-259; CONF-781247—6). Dep. NTIS, PC A02/MF A01.

From 2. international conference on energy storage, compression and switching; Venice, Italy (5 Dec 1978).

An x-ray laser pumped by synchrotron radiation from an electron storage ring is proposed. (GHT)

17945 **Tunable, ultrahigh spectral brightness KrF* excimer laser source.** Hawkins, R.T.; Egger, H.; Bokor, J.; Rhodes, C.K. (Department of Phsyics, University of Illinois at Chicago Circle P. O. Box 4348, Chicago, Illinois 60680). ED-78-S-08-1603. *Appl. Phys. Lett.;* **36**: No. 6, 391-392(15 Mar 1980).

An extremely high spectral brightness KrF* (248 nm) excimer source is described. This instrument combines the property of continuous tunability over the full gain profile with the following output pulse characteristics: pulse energy ~60 mJ, pulse duration ~10 nsec, spectral width 15030 MHz, absolute frequency control to within 300 MHz, and beam divergence ~50 μrad. Within the uncertainty of measurement, the spectral width of the output radiation is Fourier transform limited, and the beam divergence corresponds to the diffraction of the radiating aperture.

17946 **Exact cavity equations for lasers with large output coupling.** Siegman, A.E. (Department of Electrical Engineering and Edward L. Ginzton Laboratory, Stanford University, Stanford, California 94305). *Appl. Phys. Lett.;* **36**: No. 6, 412-414(15 Mar 1980).

The author shows how to write an exact cavity-mode expansion and obtains formally simple yet exact equations of motion for real laser cavities with large output coupling and/or diffraction losses, using the actual transverse eigenmodes of the cavity as a basis set, and including fast transient variations, externally injected signals, and spontaneous emission noise.

17947 **Atlas for optogalvanic wavelength calibration.** Keller, R.A.; Engleman, R. Jr.; Palmer, B.A. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Appl. Opt.;* **19**: No. 6, 836-837(15 Mar 1980).

The accuracy of laser wavelength calibration was demonstrated using a uranium hollow cathode discharge tube. (AIP)

17948 **High-efficiency wavefront reversal in germanium and in inverted CO_2 (review).** Bigio, I.J.; Feldman, B.J.; Fisher, R.A.; Bergmann, E.E. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Sov. J. Quant. Electron. (Engl. Transl.);* **9**: No. 11, 1365-1369(Nov 1979).

The first observations were made of phase-conjugate reflection at 10.6 μ. A novel intracavity technique of general utility for any oscillating laser system was used. In one arrangement, germanium was placed in a TEA CO_2 laser cavity to utilize the intracavity counterpropagating (strong) waves in degenerate four-wave mixing. Reflectivities up to 20% were obtained. In a second arrangement, phase-conjugate reflection and amplification with an effective gain in excess of unity was achieved by redirecting the output of a TEA CO_2 laser oscillator into its own active medium. The strong counterpropagating waves coupled with the saturated-gain medium to provide nonlinearity in a process analogous to degenerate four-wave mixing.

17949 (LA-tr—79-46) **Project Group for Laser Research. PLF annual report, 1978.** (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V., Garching (Germany, F.R.). Projektgruppe fuer Laserforschung). 1979. Translation source information not available. 142p. Dep. NTIS, PC A07/MF A01.

The organization and development of the Project Group for Laser Research are discussed. Cooperation of the Group with other scientific and technical institutions is noted. Research in the Departments of Plasma Physics and High Power Laser Development; Laser Chemistry; and Laser Spectroscopy is summarized. The isotope-selective excitation of UF_6 which is of interest in connection with uranium isotope separation, requires a laser which can be tuned exactly to an absorption line of the molecule in the region λ equals 16 μm. In the URANIT/PLF Project, possibilities for producing such radiation was studied.

17950 **Electronic transition lasers. II.** Wilson, L.E.; Suchard, S.N.; Steinfeld, J.I. (eds.). Cambridge, MA; Massachusetts Institute of Technology Press (1977). 354p. (CONF-760949—).

From 3. colloquium on electronic transition lasers; Aspen, CO, USA (7 Sep 1976).

Separate papers have been prepared for individual papers. (TFD)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 17813

17951 **Low energy H atom analyzer using a cesium heat pipe.** Brisson, D.; Baity, F.W.; Quon, B.H.; Ray, J.A.; Barnett, C.F. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Rev. Sci. Instrum.;* **51**: No. 4, 511-515(Apr 1980).

The efficiency of detecting H and D atoms ($E<1$ keV) escaping a plasma has been increased by use of a cesium vapor cell to form negative ions by electron attachment collisions. A 30 cm long heat pipe confines the cesium to a localized region. The resulting negative ions are energy analyzed with a single-channel, parabolic parallel-plate analyzer and detected by a channel multiplier. The H^0 conversion efficiency was 10^{-2} at 100 eV, increasing to 3.8×10^{-2} at 500 eV. For a H^0 energy of 100 eV, the analyzer is 2.5 orders of magnitude more efficient than a comparable N_2 stripping cell analyzer. The analyzer has been used to measure ion temperatures as low as 30 eV on the EBT Plasma experiment.

MATERIALS TESTING

17952 **Electromechanical polishing of metal spheres.** Miller, N.E.; Engelhaupt, D.E. (The Bendix Corporation, Kansas City Division, P.O. Box 1159, Kansas City, Missouri 64141). DE-AC04-76-DP00613. *Rev. Sci. Instrum.;* **51**: No. 4, 551-552(Apr 1980).

Equipment has been developed to electromechanically polish metal spheres. Mechanical polishing is accomplished by the action of three cup-shaped laps which rotate against the sphere. An abrasive slurry containing an electrolyte is continuously applied to the sphere and laps. Electrochemical etching is accomplished by applying a positive potential to two of the laps and a negative potential to the third.

SAFETY ENGINEERING

17953 (K/D—5077) **Impact of regulations on fire-protection engineering and design.** Blackmon, J.T. Jr.; Teague, P.J. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 20 Feb 1980. Contract W-7405-ENG-26. 20p. (CONF-800212—3). Dep. NTIS, PC A02/MF A01.

From 7. annual energy conference and exhibition during National Engineers' week; Knoxville, TN, USA (20 Feb 1980).

Guidelines for fire protection engineering are discussed and national legislation dealing with health and safety is reviewed. The scope of the subject was expanded to include: the concept of the safety professional; a definition of safety that may be applicable not only to fire-protection engineering but also to other disciplines; and a methodology that might enable the fire-protection engineer to orga-

nize his or her approach to cope with the increasing regulatory burden. 19 references, 7 figures.

17954 (LIB-tr—4850) **VDE-regulation for the construction of electrical installations in areas subject to explosion hazards.** (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.); Verband Deutscher Elektrotechniker (VDE) e.V., Frankfurt am Main (Germany, F.R.). Deutsches Komitee fuer Elektrowaerme). 1979. Translation of German Standard No. DIN 57165. 54p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Scope, general points, and subdivision of areas subject to explosion hazard into zones are presented. In Section 4, General requirements for all hazardous areas, are detailed, followed by details of the standard requirements for areas that are hazardous due to combustion gases, vapors, and fogs. Section 6 covers the requirements for areas made hazardous by combustible dusts. Special requirements for hazardous areas that are not subject to the Ex-Order (identical with VDE 0165/8.69, sub-section 22; special requirements) are discussed in an appendix. Many tables are given that tabulate data on the characteristics of combustibles.

ELECTRONIC CIRCUITS AND DEVICES

17955 (BDX—613-2332) **Comparison of metallization systems for thin film hybrid microcircuits. Part I. Fabrication and lead frame bondability.** Hines, R.A.; Raut, M.K. (Bendix Corp., Kansas City, MO (USA)). Nov 1979. Contract EY-76-C-04-0613. 17p. (CONF-800118—2). Dep. NTIS, PC A02/MF A01.

From 2. AES design and finishing of printed wiring and hybrid circuits symposium; San Francisco, CA, USA (15 Jan 1980).

Cr/Pd/Au and Ti/Pd/Au metallization systems with either evaporated or electroplated gold were evaluated relative to the currently used Cr/Au (evaporated) system. A description of the five systems and the process steps used to fabricate thin film networks are discussed. Over 7000 leads from thermocompression bonded lead frames were pull tested to determine the bondability and adhesion characteristics of the film.

17956 (BDX—613-2336) **Comparison of metallization systems for thin film hybrid microcircuits. Part II. Corrosion susceptibility and solderability.** Raut, M.K.; Hines, R.A. (Bendix Corp., Kansas City, MO (USA)). Nov 1979. Contract EY-76-C-04-0613. 11p. (CONF-800118—1). Dep. NTIS, PC A02/MF A01.

From 2. AES design and finishing of printed wiring and hybrid circuits symposium; San Francisco, CA, USA (15 Jan 1980).

Corrosion susceptibility and solderability were evaluated for thin film Cr/Pd/Au, Ti/Pd/Au, and the currently used evaporated chromium/gold system. Both evaporated and electroplated gold were included in the Cr/Pd/Au and Ti/Pd/Au samples. For the corrosion susceptibility evaluation, circuits from each system were exposed to various solutions used in the fabrication process, and the percent change in interface resistance was measured as a function of time. For the solderability evaluation, solder filled via resistance and solder bond strengths were measured after temperature cycling. The electroplated gold systems with a palladium layer showed better corrosion resistance and solderability than evaporated chromium/gold.

17957 (LA-UR—80-667) **Fiber-optic technology review.** Lyons, P.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-800322—2). Dep. NTIS, PC A02/MF A01.

From Defense Nuclear Agency meeting; Washington, DC, USA (25 Mar 1980/REPLACED BY CONF-800307).

A history of fiber technology is presented. The advantages of fiber optics are discussed (bandwidth, cost, weight and size, nonmetallic construction and isolation). Some aspects of the disadvantages of fiber systems briefly discussed are fiber and cable availability, fiber components, radiation effects, receivers and transmitters, and material dispersion. Particular emphasis over the next several years will involve development of fibers and systems optimized for use at wavelengths near 1.3 μm and development of wavelengths multiplexers for simultaneous system operation at several wavelengths.

17958 (UCID—18553) **Test of a vacuum/dielectric surface flashover switch.** Smith, I.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1980. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

A vacuum surface flashover switch is being considered for > 10 kHz operation in a 250 kV, 10 ohm, 40 ns coaxial water Blumlein. Various possible switch designs are compared, and two promising ones selected for tests in the switch test facility at LLL. The initial test configurations are described.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 17478, 17823, 17824

17959 **Economic impacts of a hazardous waste manifest system.** Raufer, R. (ETA Engineering, Inc., Oak Brook, IL); Croke, K. pp 495-500 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The Resource Conservation and Recovery Act of 1976 requires individual states to develop a hazardous waste manifest system. A more comprehensive manifest system has recently been proposed in Illinois, and an assessment was performed to determine the economic impacts of the proposed regulation. This assessment determined that the manifest system would have minimal impacts on the Illinois economy.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 17312, 17809

POLLUTION CONTROL EQUIPMENT

17960 **Stabilization of power plant scrubbing slurries and fine coal refuse with the additive Calcilox.** Labovitz, C. (Dravo Lime Co., Pittsburgh, PA). pp 79-83 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Based on test results several conclusions may be drawn on the positive effects of stabilization of power plant scrubbing slurries and fine coal refuse when mixed with Calcilox: (1) sludges harden when mixed with Calcilox; (2) the strength of the treated sludges increases with increased solid content, percent additive, curing time, and temperature; (3) permeability of sludges and coal fines decreases with increasing solid content and percent additive; and (4) disposal of treated materials is possible, and such sites can be utilized in land developments.

17961 **Thiosorbic flue gas desulfurization process: a history of operations.** Stewart, D.A.; Selmeczi, J.G. (Dravo Corp., Pittsburgh, PA). pp 386-391 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Data from commercial operating units show that the desired SO_2 removal efficiency can be achieved with Thiosorbic lime. Operating experience has shown that gypsum scaling has not been a major problem when using Thiosorbic lime. Minor scaling has been observed only during periods of difficulty with pH control. Mist eliminators can be maintained free of scale by washing with thickener overflow return. Some problems encountered with solid build-up are thought to be caused by mechanical problems.

17962 **FW-BF System with REDOX: a status report.** Beckman, E.B. (Foster Wheeler Energy Corp., Livingston, NJ). pp 392-397 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper deals with two subjects: the Foster Wheeler-Bergbau Forschung Dry Adsorption System (FW-BF system) with RESOX as an integral part and RESOX as a separate entity having applications beyond that associated with FW-BF.

17963 **Recent operating experience of the Wellman-Lord FGD Process on a coal-fired boiler.** Delgado, F.F. (Davy Powergas Inc., Lakeland, FL). pp 398-403 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses the Wellman-Lord SO_2 Recovery Process developed by Davy Powergas in the late 1960's. The process has proven itself to be operationally reliable and has met or surpassed governmental regulations regarding SO_2 emissions. It can be applied to any flue gas containing SO_2.

17964 Research-Cottrell/Bahco SO_2 and particulate removal system at Rickenbacker Air Force Base. McCarthy, J.E. (Research-Cottrell, Inc., Bound Brook, NJ). pp 421-427 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper describes the operation of the R-C/Bahco process at Rickenbacker Air Force Base (RAFB). The process is capable of 95 to 99% removal of particulates and sulfur dioxide from process gases and from the flue gases of oil-and-coal-fired boilers. The flue gas scrubber for the seven boilers at RAFB is the first industrial size SO_2 and particle removal system using lime as the scrubbing medium and specifically designed for industrial applications. The process is particularly suitable for small and medium size installations, generally those with a gas flow of 15,000 to 100,000 standard cubic feet per minute (scfm). This is roughly equivalent to the respective flue gas outputs of plants generating 60,000 to 300,000 lb of steam per hour or 6 to 40 MW of power. This range is for the typical module. For large volumes, more than one module is utilized. The R-C/Bahco system is suitable for cleaning flue gas from combustion of coal, petroleum, wood, sludge and most other fuels. It is also applicable to off-gas streams from many industrial processes including the manufacture of paper and glass, refining of petroleum, sintering and smelting or metals and incineration. In brief, the process may be used in almost any small to medium size plant where high efficiency removal of sulfur oxides and particulates is desired.

17965 Particulate control for coal-fired industrial boilers. Noe, N.D.; Bruck, J.M. (PEDCo Environmental, Inc., Cincinnati, OH). pp 428-433 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Major items for evaluating particulate control devices for coal-fired boiler application are discussed. These items include: (1) efficiency required to assure compliance with applicable particulate emission standards, (2) characteristics of a long-term coal supply, (3) average operating pressure drop, (4) advantages and disadvantages of long-term flue gas characteristics to both types of equipment, (5) land availability, and (6) cost competitiveness. Also discussed are electrostatic precipitators and fabric filters.

17966 Direct reduction of sulfur dioxide. Buenrostro, J.; Wilson, D.B. (New Mexico State Univ., Las Cruces). pp 441-446 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The increased use of coal as an industrial/electrical power energy source potentially will increase the sulfur oxide emissions from 34.2 million tons in 1970 to 61.6 million tons in 1990. (1) All current and new sulfur recovery processes for control of this sulfur dioxide emission should have certain desirable characterisitcs - simplicity, minimal disposal problems, and sulfur in a marketable form. These requirements are met by the direct gas phase reduction of sulfur dioxide; however the problems remaining before the widespread utilization of this process are economical reducing gases and effective catalysts.

17967 Simultaneous nitrogen oxides and sulfur dioxide removal by absorption-reduction scrubbing. Sekiya, T. (Asahi Chemical Industry Co., Ltd., Tokyo, Japan); Ellison, W. pp 447-452 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper discusses advances in flue gas treatment for NO/sub x/ removal that have recently been made in Japan. Technology appropriate to medium to high sulfur fuel applications has been established for simultaneous wet collectiion of SO/sub x/ and NO/sub x/ in a single scrubbing step without addition of oxidizing reagents.

RANKINE

REFER ALSO TO CITATION(S) 17827

STIRLING

REFER ALSO TO CITATION(S) 17519, 17828

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 18164

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

17968 Low energy ion beam transport by permanent magnets. Ehlers, K.W.; Leung, K.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Rev. Sci. Instrum.;* **51**: No. 4, 500-503(Apr 1980).

The guiding of a 300 eV divergent hydrogen ion beam by a surface magnetic field generated by samarium cobalt magnets has been investigated. It was found that magnets arranged in a multi-ring-cusp configuration produced the best beam transport efficiency.

AUXILIARIES AND COMPONENTS

ION SOURCES

17969 Pulsed vapor source for use in ion sources for heavy-ion accelerators. Shiloh, J.; Chupp, W.; Faltens, A.; Keefe, D.; Kim, C.; Rosenblum, S.; Tiefenback, M. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Appl. Phys. Lett.;* **36**: No. 7, 537-539(1 Apr 1980).

A pulsed cesium vapor source for use in ion sources for high-current heavy-ion accelerators is described. The source employs a vacuum spark in Cs and its properties are measured with a hot-filament Cs detector.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 18148

17970 (BNL—27324) Hadron spectroscopy in the Brookhaven multiparticle spectrometer. Foley, K.J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 20p. (CONF-791174—4). Dep. NTIS, PC A02/MF A01.

From Meeting on two-nucleon systems and dibaryon resonances; Hiroshima, Japan (Nov 1979).

The Brookhaven multiparticle spectrometer is described, and experiments being performed with it are discussed. (GHT)

STORAGE RINGS

REFER ALSO TO CITATION(S) 17944

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 18173

17971 (LBL—9813) Passive detectors. Thomas, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 47p. Dep. NTIS, PC A03/MF A01.

Nuclear emulsion, activation detectors, integrating ionization chambers and thermoluminescent detectors, all of which are passive radiation detectors, are discussed. (FS)

17972 Evaluation of high efficiency CsI and CuI photocathodes for soft x-ray diagnostics. Saloman, E.B.; Pearlman, J.S.; Hen[1]e, B.L. (U.S. National Bureau of Standards, Center for Radiation Research,

Synchrotron UV Radiation Facitity, Washington, D.C. 30234). *Appl. Opt.;* **19**: No. 5, 749-753(1 Mar 1980).

The photoefficiency of CsI and CuI photocathodes was measured for photons in the 22—240 eV (50—560-A) energy range. The within-batch and batch-to-batch variation in photoefficiency were studied as was the sensitivity of the samples to storage under dry nitrogen. The effect of exposure to air was investigated. The shape of the photoefficiency curves was found to agree quite well with that expected from the photoabsorption cross sections of the materials. CsI in particular appears useful as a detector in soft x-ray diagnostics, especially as a narrowband detector in the 100-eV photon energy range where peak measured efficiencies can exceed 300%.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 17971

17973 Investigation of cables for ionization chambers. Spokas, J.J.; Meeker, R.D. (Physical Sciences Laboratory, Illinois Benedictine College, Lisle, Illinois 60532). EY-76-5-02-0323. *Med. Phys.;* **7**: No. 2, 135-140(Mar 1980).

Seven coaxial cables which are in use for carrying currents generated in ionization chambers have been critically studied with reference to their suitability to this application. Included in this study are four low-noise triaxial cables and three low-noise two-conductor cables. For each cable the following characteristics were considered: inherent noise currents, currents produced by cable movements, polarization currents, the degree of electrostatic shielding of the central signal-carrying conductor, and radiation-induced cable currents. The study indicated that of the seven cables, two low-noise triaxial cables, both employing solid Teflon dielectric surrounding the central conductor, appear to offer the best overall performance for use with ionization chambers.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 17971

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 17977

17974 (LA-UR—80-390) **Materials analysis with a nuclear microprobe.** Maggiore, C.J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 51p. (CONF-800413—1). Dep. NTIS, PC A04/MF A01.

From Scanning electron microscopy meeting; Chicago, IL, USA (22 Apr 1980).

The ability to produce focused beams of a few MeV light ions from Van de Graaff accelerators has resulted in the development of nuclear microprobes. Rutherford backscattering, nuclear reactions, and particle-induced x-ray emission are used to provide spatially resolved information from the near surface region of materials. Rutherford backscattering provides nondestructive depth and mass resolution. Nuclear reactions are sensitive to light elements ($Z < 15$). Particle-induced x-ray analysis is similar to electron microprobe analysis, but 2 orders of magnitude more sensitive. The focused beams are usually produced with specially designed multiplets of magnetic quadrupoles. The LASL microprobe uses a superconducting solenoid as a final lens. The data are acquired by a computer interfaced to the experiment with CAMAC. The characteristics of the information acquired with a nuclear microprobe are discussed; the means of producing the beams of nuclear particles are described; and the limitations and applications of such systems are given.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 18096

17975 (SAND—79-1885C) **Rugged calorimeter with a fast rise time.** McMurtry, W.M.; Dolce, S.R. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 14p. (CONF-800502—1). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

An intrinsic 1-mil-thick gold foil calorimeter has been developed which rises to 95% of the energy deposited in less than 2 microseconds. This calorimeter is very rugged, and can withstand rough handling without damage. The time constant is long, in the millisecond range, because of its unique construction. Use of this calorimeter has produced 100% data recovery, and agreement with true deposition to less than 10%.

17976 (SAND—80-0362C) **High temperature, radiation hardened electronics for application to nuclear power plants.** Gover, J.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 12p. (CONF-800119—1). Dep. NTIS, PC A02/MF A01.

From NRC/IEEE working conference on advanced electrotechnology applications to nuclear power plants; Washington, DC, USA (15 Jan 1980).

Electronic circuits were developed and built at Sandia for many aerospace and energy systems applications. Among recent developments were high temperature electronics for geothermal well logging and radiation hardened electronics for a variety of aerospace applications. Sandia has also been active in technology transfer to commercial industry in both of these areas.

17977 (UCRL—84027) **Microcomputer controlled Isocon camera system.** Dunbar, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1980. Contract W-7405-ENG-48. 7p. (CONF-800502—2). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

An Isocon camera system is described which uses an 8080 microcomputer system for its control. Horizontal synchronized operational power supplies are used with a DAC for each channel of control. Each control function is entered by way of a key-board and software. Video information is digitized by a fast ADC and serialized to a low nibble and high nibble. Performance of the camera in terms of SNR and limiting resolution are discussed as well as block diagrams showing how the system was constructed.

17978 Random array grid collimators. Fenimore, E.E.; Blake, R.L. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Rev. Sci. Instrum.;* **51**: No. 4, 445-453(Apr 1980).

X-ray collimators using grid patterns which are random offer several significant advantages over collimators using periodic grids. In particular, random array grid collimators (RAGC's) eliminate the requirement that there be very closely spaced grids if a wide field of obscuration outside the central peak is desired. The RAGC should be less susceptible to systematic off-axis leaks, and the RAGC has a better high energy response than a periodic grid collimator. The random array technique can also be used to produce converging or diverging collimators. A general theory is presented which predicts the angular response of a RAGC. It is shown that pure random arrays have two problems: there are strong wings in the response function and the patterns are not self-supporting. Restrictions on the randomness of the pattern are suggested which eliminate these problems but at the price of putting an upper limit on the available throughput. However, even in the worst case, the upper limit for a two-dimensional collimator is as high as 23%. In other cases, throughputs the order of 40% are possible with two-dimensional collimators and of 50% with one-dimensional collimators. These techniques can provide 10 arc second two-dimensional collimators with a large collecting area. Suggestions are presented for easing the fabrication effort of the grids.

17979 Microprocessor-based oceanographic particle data collection system. Brown, J.C. (National Marine Fisheries Service, La Jolla, CA). pp 3C.1-3C.4 of Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

An instrument has been developed for oceanographic sampling of particle density and size versus depth and temperature in a 100 meter water column. The sensor probe, although attached to a lightweight cable, is allowed to free fall, which effectively detaches it from the motion of the sampling platform and enhances the resolution of thin particle layers. Sensor information is transmitted up the cable to a small, dedicated, microcomputer module where it is digitized and stored on cassette tape with read and after write verification. The microcomputer also keeps the operator informed of the status of the drop and displays the recorded data on a video monitor.

17980 Effectiveness of the distributed sensor concept for underwater detection. Polvani, D.G. (Westinghouse Electric Corp., Annapolis, MD). pp 15A.1-15A.6 of Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

Two approaches to shallow water surveillance - a system of distributed sensors and conventional line barriers - are discussed. Analytical models are developed to compare the two approaches on the basis of probability of detection performance versus number of sensors required. Sensor range and cost are critical factors for the distributed system. Applications for offshore US facilities, foreign sales, and deep water surveillance aaugmentation depend on achieving a low cost system with adequate range. Useful applications for

distributed sensor systems consisting of elementary sensors occur when surveillance of an open area against noisy targets is required and use of sophisticated acoustic array techniques is too expensive or restricted. While distributed sensor systems are preferred in open area situations or where large near shore areas must be defended, barrier systems are preferred at choke points whose geometry defines a natural line barrier.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 17619

EXPLOSIONS AND EXPLOSIVES

17981 Simulation of the burst phase of exploding wires. Baker, L. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **51**: No. 3, 1439-1442(Mar 1980).

A one-dimensional magnetohydrodynamic code is used to simulate the explosion of a wire caused by the passage of a large electric current. Comparison with experimental results shows good agreement is achieved for a variety of wire materials and diameters until the time of "burst" or vaporization of the wire.

CHEMICAL

17982 (LA—8075) **Numerical modeling of the minimum priming charge test.** Forest, C.A. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

The minimum priming charge test is modeled in one-dimensional symmetry using the SIN hydrodynamic code and the Forest Fire decomposition rate model. Calculated and experimental values of the minimum priming charge for PBX 9404 and Comp. B are compared. The sensitivity of the calculations to the Pop plot input for the Forest Fire decomposition rates and to the Extex booster charge equation of state is examined.

17983 (MHSMP—80-04) **Dynamic mechanical analysis of LX-13, an extrudable explosive.** Flowers, G.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1980. Contract EY-76-C-04-0487. 34p. Dep. NTIS, PC A03/MF A01.

Work using a Rheometrics Mechanical Spectrometer to characterize LX-13, an extrudable explosive comprised of Sylgard 182 and PETN is reported. Characterization included evaluating four lots of LX-13 of various extrudability and determining isothermal curing properties as functions of time. The dynamic shear storage and loss moduli as functions of temperature were also determined for cured samples. It was found that LX-13 requires a considerably longer time period to completely cure than had previously been thought. The glass transition temperature was found to be ~ -125°C and the crystalline melting temperature was found to be -40°C, the same as the binder, polydimethylsiloxane. For the lots of LX-13 tested, the cure rate was found to vary as much as 60% between lots.

17984 (UCID—18547) **Shock initiation of bare- and covered-PBX-9404 charges by projectile impact. Final report.** Vantine, H.C. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-EBG-48. 47p. Dep. NTIS, PC A03/MF A01.

The shock initiation threshold of bare- and cased PBX-9404 explosives is being determined. The shocks are produced by the impact of steel projectiles in the velocity range of 0.5 to 5.0 km/s. Impacts in the 0.5 to 2.0 km/s range are being studied with a combination of experimental and calculational techniques. Impacts in the 2.0 to 5.0 km/s range will initially be studied only with calculational techniques. This first phase of the program addresses only normal impact.

17985 (UCID—18578) **Permeability of a polyurethane membrane, Halthane 73-18, to aqueous ammonium chloride.** Leider, H.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1978. Contract W-7405-ENG-48. 15p. Dep. NTIS, PC A02/MF A01.

Conclusions of this study are (1) that a thin Halthane 73-18 film is not permeable to NH_4Cl from a concentrated solution, and (2) that an intact Halthane coating on TATB would almost certainly protect metals adjacent to the explosive from attack by ammonium chloride.

NUCLEAR

WEAPONRY

17986 (UCID—18522) **Alternate approaches to system EMP response assessment.** Bevensee, R.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1980. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

The outlined assessment approaches of system EMP response as developed by LLL are based on either experimental low-level simulator excitation or surface current injection testing. The advantages and disadvantages compared to electromagnetic pulse assessment techniques by other organizations are noted. Subthreat excitation of a full-scale system or of scale model on a transient electromagnetics facility is described. This assessment yields the linear external or internal response. A proposed procedure for surface current injection testing (SCIT) of either a full-size or scale model system at the subthreat level or a full-size system at the threat level is discussed. The full-threat testing enables assessment of the system nonlinear internal response. Some of the modeling errors involved in the assessment of EMP response of a real system in a threat environment are briefly discussed.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 18000

BASIC STUDIES

17987 (DOE/EV—0057(Vol.1)) **Inventory of Federal energy-related environment and safety research for FY 1978. Volume 1. Executive summary.** (Department of Energy, Washington, DC (USA). Office of Program Coordinator). Dec 1979. 119p. Dep. NTIS, PC A06/MF A01.

The FY 1978 Federal Inventory is a compilation of 3225 federally funded energy-related environmental and safety reserch projects. It consists of three volumes: an executive summary providing an overview of the data (Volume I), a catalog listing each Inventory project followed by series of indexes (Volume II), and an interactive terminal guide giving instructions for on-line data retrieval (Volume III). Volume I reviews the inventory data as a whole and also within each of three major categories: biomedical and environmental research, environmental control technology research, and operational safety research.

17988 (DOE/EV—0057(Vol.2)) **Inventory of Federal energy-related environment and safety research for FY 1978. Volume II. Project listings and indexes.** (Department of Energy, Washington, DC (USA). Office of Program Coordinator). Dec 1979. 918p. Dep. NTIS, PC A99/MF A01.

This volume contains summaries of FY-1978 government-sponsored environment and safety research related to energy. Project summaries were collected by Aerospace Corporation under contract with the Department of Energy, Office of Program Coordination, under the Assistant Secretary for Environment. Summaries are arranged by log number, which groups the projects by reporting agency. The log number is a unique number assigned to each project from a block of numbers set aside for each agency. Information about the projects is included in the summary listings. This includes the project title, principal investigators, research organization, project number, contract number, supporting organization, funding level if known, related energy sources with numbers indicating percentages of effort devoted to each, and R & D categories. A brief description of each project is given, and this is followed by subject index terms that were assigned for computer searching and for generating the printed subject index in Volume IV.

17989 (SAND—79-1180) **Time delay, pulse stretching, and radiance distribution for 532-nm laser pulses propagating in atmospheric clouds with application to satellite optical ranging.** Bradley, R.G.; Matter, J.C. (Sandia Labs., Albuquerque, NM (USA)). Feb 1980. Contract EY-76-C-04-0789. 62p. Dep. NTIS, PC A04/MF A01.

A light pulse traveling through clouds is altered by collisions with water drops in two ways: the arrival time of the pulse is delayed, and the pulse shape is stretched in time. Until now, little experimental data existed to confirm or refute theoretical models of these time smearing effects. This study provides new data, and the authors have developed a relatively simple methodology to generate the time effects for any particular satellite or ground-based receiver.

17990 Comparison of mean wind speeds and turbulence at a coastal site and an offshore location. SethuRaman, S.; Raynor, G.S.

(Atmospheric Sciences Division, Department of Energy and Environment, Brookhaven National Laboratory, Upton, NY 11973). EY-76-C-02-0016. *J. Appl. Meteorol.;* **19**: No. 1, 15-21(Jan 1980).

Observations of mean wind speed and longitudinal turbulence at a height of 8 m over the Atlantic ocean, 5 km off Long Island, New York, were compared with simultaneous observations at the beach. Results were grouped into wind direction classes characteristic of changes in roughness and fetch. Mean winds over the ocean were 15—100% higher than those at the beach. Changes in turbulence seem to depend on variations in the aerodynamic roughness of the sea surface and the thermal processes that take place over the water. A decrease in turbulence over the ocean relative to that at the beach due to a decrease in sea surface roughness for alongshore flows could be predicted reasonably well with a simple logarithmic wind profile relationship.

17991 Objective analysis technique for constructing three-dimensional urban-scale wind fields. Goodin, W.R.; McRae, G.J.; Seinfeld, J.H. (Environmental Quality Laboratory, California Institute of Technology, Pasadena 91125). EY-76-G-03-1305. *J. Appl. Meteorol.;* **19**: No. 1, 98-108(Jan 1980).

An objective analysis procedure for generating mass-consistent, urban-scale three-dimensional wind field is presented together with a comparison against existing techniques. The algorithm employs terrain following coordinates and variable vertical grid spacing. Initial estimates of the velocity field are developed by interpolating surface and upper level wind measurements. A local terrain adjustment technique, involving solution of the Poisson equation, is used to establish the horizontal components of the surface field. Vertical velocities are developed from successive solutions of the continuity equation followed by an iterative procedure which reduces anomalous divergence in the complete field. Major advantages of the procedure are that it is computationally efficient and allows boundary values to adjust in response to changes in the interior flow. The method has been successfully tested using field measurements and problems with known analytic solutions.

17992 Relationship between mean and extreme temperatures in diverse microclimates. Hinds, W.T.; Rotenberry, J.T. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830;E(45-1)-2402. *Ecology;* **60**: No. 5, 1073-1075(Oct 1979).

Routine measurement of periodic extremes (weekly, monthly, etc.) is an attractive method of gathering temperature data, because ecological investigations often are conducted on remote locations, and usually are spread out over several sites. However, if measurement of extremes is simpler, but averaging seems better for long-range study, some logical questions then arise: (1) Does a relationship exist between extreme temperatures and average extreme temperatures? (2) If so, what is the relationship and how strong is it? These questions do not seem to have been discussed in relation to temperature. This paper offers an ecologically meaningful answer to both questions by empirically demonstrating such relationships for nine microclimatic sites over a 1000-m elevational gradient.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 17365, 18094

17993 (EML—371(App.), pp B.1-B.119) **Chemical composition of atmospheric deposition.** Feely, H.W.; Larsen, R.J. 1 Apr 1980.

In Appendix to Environmental Measurements Laboratory environmental quarterly.

The Environmental Measurements Laboratory (EML) is studying the effects of changes in patterns of energy use upon the major element and trace element chemical composition of precipitation, dry deposition and total deposition. Samples of wet, dry and total deposition are collected on a monthly basis at seven sites within the conterminous United States. The main objective is to gather data on the geographical differences and time trends in precipitation chemistry and in concentrations of pollutants in deposition. These will be related to changing rates of use of various fuels and especially to increasing rates of coal combustion.

17994 (EPRI-EA—1267) **Characterization of the EPRI Differential Absorption Lidar (DIAL) System. Final report.** Baumgartner, R.A.; Depp, J.G.; Evans, W.E.; Grant, W.B.; Hawley, J.G.; March, R.G.; Murray, E.R.; Proctor, E.K. (SRI International, Menlo Park, CA (USA)). Dec 1979. 103p. Dep. NTIS, PC A06/MF A01.

SRI International designed and constructed a DIfferential Absorption Lidar (DIAL) to provide EPRI with a mobile field system for remote measurements of SO_2, NO_2, and O_3. After field testing the lidar was prepared for the sytem calibration testing where lidar measurements were compared to in situ profiles of SO_2, NO_2, and O_3. This two-week field program determined overall system accuracy and reliability in measuring varying ambient gas concentrations. The lidar was then returned to SRI for detailed subsystem performance evaluations. Improvements were made wherever possible, and the lidar was prepared for further systems tests. Tests were made using an NO_2 sample chamber to simulate a calibrated NO_2 plume, and ambient measured NO_2 concentrations were compared with values from a regional air pollutant monitoring station. Following the local calibration and the systems field tests, SRI evaluated the performance and reliability of the EPRI lidar. Based on that evaluation, SRI undertook a major analysis of possible system improvements. Although the remote measuring capability had been successfully demonstrated in the field program, SRI makes several recommendations for systems improvements which would increase the lidar accuracy and reliability.

17995 (LA—7978-PR) **Development of a sampling and analytical method for ethylenimine. Progress report, January 1-October 31, 1978.** Morales, R.; Stampfer, J.F.; Hermes, R.E.; Campbell, E.E.; Ettinger, H.J. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 14p. Dep. NTIS, PC A02/MF A01.

A sampling and analytical method to monitor ethylenimine in air is described. Ethylenimine was designated as a carcinogen by the Occupational Safety and Health Administration in 1974. A midget bubbler containing Folin's reagent was used to collect ethylenimine vapors from laboratory generated challenge atmospheres. Folin's reagent converts ethylenimine vapors to 4-(1-aziridinyl)-1,2-naphthoquinone, which is extracted and analyzed by high performance liquid chromatography. The method was evaluated over the range 1.2 to 795 μg/sample and has a precision of 7%.

17996 (PNL—3300(Pt.5), pp 11-13) **Regional assessments.** Feb 1980.

In Pacific Northwest Laboratory annual report for 1979 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health, and safety.

The principal work conducted by Pacific Northwest Laboratory for the Regional Assessment Division in FY 1979 was analysis of the consequences from and constraints applicable to the possible use of a specified mix of energy technologies in Federal Region X (Alaska, Washington, Oregon, and Idaho). The mix of technologies considered was reflective of the National Energy Plan as that plan was proposed by the President of the United States in 1977. This analysis was conducted in cooperation with other national laboratories, each of which focused on one or more of the other Federal Regions. The aggregate national analysis comprised the Regional Issues Identification and Assessment program.

17997 (UCRL—83269) **Numerical wind field model validation in complex terrain with application to pollutant transport.** Porch, W.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1980. Contract W-7405-ENG-48. 7p. (CONF-800327—3). Dep. NTIS, PC A02/MF A01.

From 2. joint conference on applications of air pollution meteorology; New Orleans, LA, USA (24 Mar 1980).

The interaction of meteorological data taken at points in a region with numerical models can be done smoothly in gently varying terrain. However, it is fraught with difficulties in complex terrain. Computer memory size limits the resolution of the topography and a point measurement becomes representative of smaller scales as the topography becomes more complex. This paper describes how remotely sensed spatially averaged winds from optical anemometers can be used to help the interaction of wind measurements made at points within a region and numerical regional wind field models. In this paper, emphasis will be placed on model validation both as wind field estimates for applications such as wind energy prospecting, and as input to pollutant dispersion models.

17998 Probability distribution of the predicted CFM-induced ozone depletion. Ehhalt, D.H.; Chang, J.S.; Butler, D.M. (Kernforschungsanlage Juelich GmbH, Institut fuer Chemie 3 Atmosphaerische Chemie, Postfach 1913, D-5170 Juelich, Germany). *J. Geophys. Res.;* **84**: No. C12, 7889-7894(20 Dec 1979).

It is argued from the central limit theorem that the uncertainty in model predicted changes of the ozone column density is best represented by a normal probability density distribution. This conclusion is validated by comparison with a probability distribution generated by a Monte Carlo technique. In the case of the CFM-induced ozone depletion, and based on the estimated uncertainties in the reaction rate coefficients alone the relative mean standard deviation of this normal distribution is estimated to be 0.29.

17999 Sulfur trioxide permeation tube for calibration of sulfuric acid measurement methods. Dietz, R.N.; Wieser, R.F. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Anal. Chem.;* **51**: No. 14, 2388-2391(Dec 1979).

Sulfur trioxide permeation tubes were prepared and calibrated for use in evaluating the effectiveness of flue gas sampling equipment designed for determination of sulfuric acid in fossil fueled combustion sources. By diluting and passing the vapors from the liquid SO_3 permeation tube through a midget bubbler, the resulting sulfuric acid aerosol was efficiently collected by a quartz fiber filter and titrated after washing. Over the 45 to 80°C temperature range, the SO_3

permeation rate varied exponentially from about 2 to 35 μL/min with a repeatability of +-8%. At a constant temperature, the repeatability was better than +-3%. The SO_3 permeation tube had a projected refrigerated storage lifetime of 30 years, an operating lifetime of 1 month at 65°C or 1 year at 35°C, and a permeation rate suitable for calibrating H_2SO_4 flue gas monitors. As a generator for simulating atmospheric H_2SO_4 aerosol concentrations, a permeation wafer device emitting SO_3 at 0.1 μL/min was expected to have a 10-year operating lifetime at 65°C. 3 figures, 3 tables.

18000 State-of-the-art assessment of air pollution control technologies for various waste-as-fuel processes. Devitt, T.W.; Sawyer, C.J.; Hall, F.D. (PEDCo Environmental, Inc., Cincinnati, OH). pp 167-173 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

PEDCo is less than 12 months into a scheduled 36 month EPA-sponsored project to develop and slip-stream prototype air pollution control devices for control of certain emissions from various generic resource recovery technologies. Presented herein is an overview, status report summary, and preliminary waste air stream characterization for co-firing RDF and coal as pertinent to the progress of the study to date.

18001 Atmospheric dispersion and deposition of particulates. Theodore, L.; Rotando, J.; Reynolds, J. (Manhattan Coll., Bronx, NY). pp 206-211 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The body of information presented in this paper is directed to those individuals concerned with atmospheric dispersion calculations, stack design, particle deposition studies, radioactive fallout and/or fugitive dust emissions. Describing equations are developed from basic principles to predict the concentration of particulates in the atmosphere resulting from point source discharges. The equation is then applied to ground level conditions to provide information on particulate deposition rates. The limitations of the proposed equation(s) and suggestions for future work are discussed. The proposed calculational scheme should be considered only as a crude but practical approximation to the actual phenomena. Fundamental treatment of the complete physical process is difficult and has yet to be provided. Further research is required if a more accurate and pragmatic model for deposition rates is to be developed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 17439

18002 (DOE/TIC—11148) **Environmental report for calendar year 1978 on radiological and nonradiological parameters.** Evans, R.G.; Woodward, J.C. (Battelle Columbus Labs., OH (USA)). 1978. Contract W-7405-ENG-92. 64p. Dep. NTIS, PC A04/MF A01.

Radionuclide releases to the environment from Battelle's West Jefferson Nuclear Sciences and King Avenue Sites were monitored for CY 1978. This included air and water emissions from the West Jefferson and King Avenue Sites and water, grass, fish, food crop, sediment, and soil samples taken from the area surrounding the West Jefferson Site. Nonradioactive effluents in water discharged from the West Jefferson Site were also monitored.

18003 (EGG—1183-1753) **Aerial radiological survey of the area surrounding the New England Nuclear Corporation Facility, Billerica, Massachusetts. Date of survey: August 1979.** (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Dec 1979. Contract EY-76-C-08-1183. 11p. Dep. NTIS, PC A02/MF A01.

An aerial radiological survey to measure terrestrial gamma radiation was carried out over the New England Nuclear Corporation facility located in Billerica, Massachusetts. Gamma ray data were collected over a 2.8 km^2 area centered on the facility by flying north-south lines spaced 60 m apart. Processed data indicated that detected radioisotopes and their associated gamma ray exposure rates were consistent with those expected from normal background emitters, except at certain locations described in this report. Average exposure rates 1 m above the ground, as calculated from the aerial data, are presented in the form of an isopleth map. No ground sample data were taken at the time of the aerial survey.

18004 (EML—371) **Environmental Measurements Laboratory environmental quarterly, December 1-March 1, 1980.** Hardy, E.P. Jr. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Apr 1980. 170p. Dep. NTIS, PC A08/MF A01.

This report presents current information from the EML environmental programs, the Rosenstiel School of Marine and Atmospheric Science, the Air Resources Laboratories of NOAA and the Woods Hole Oceanographic Institution. The initial section consists of interpretive reports and notes dealing with tritium and zirconium-95 concentrations in the stratosphere, wet and dry deposition of radium-226, lead-210, and stable lead, and trace elements in dated sections of a lake sediment core. Subsequent sections include tabulations of quarterly strontium-90 fallout, chemical constituents of wet and dry deposition, radionuclide and trace metal concentrations in surface air, radionuclide concentrations in the lower stratosphere and strontium-90 concentrations in milk and tap water. A bibliography of recent publications related to environmental studies is also presented. Separate abstracts are prepared for individual items.

18005 (EML—371, pp I.3-I.49) **Comparison of stratospheric tritium (as HTO) and zirconium-95 burdens from the high yield Chinese nuclear tests of June 27, 1973 and November 17, 1976.** Mason, A.S. (Rosenstiel School of Marine and Atmospheric Science, Miami, FL); Hut, G.; Telegadas, K. 1 Apr 1980.

In Environmental Measurements Laboratory environmental quarterly, December 1-March 1, 1980.

The depletion of the stratospheric burdens of particulate Zr-95 and gaseous HTO attributed to the November 17, 1976 Chinese high yield test indicates both have about the same residence half time (10 months) for up to 3 years after input. This indicates that gravitational settling of particles in the lower stratosphere can be considered to be negligible in studying transport processes. The rate of depletion of the stratospheric burden of HTO from the high yield Chinese test of June 27, 1973 is not as conclusive, in part, due to greater uncertainties in calculating the stratospheric burdens.

18006 (EML—371, pp I.51-I.58) **Wet and dry deposition of ^{226}radium, ^{210}lead and stable lead in an urban environment.** Fisenne, I.M.; Perry, P.M.; Keller, H.W. 1 Apr 1980.

In Environmental Measurements Laboratory environmental quarterly, December 1-March 1, 1980.

Monthly collections of wet and dry deposition in New York City were analyzed for ^{226}Ra, ^{210}Pb and stable lead over a 2 1/2 year period. The major fractions of the ^{226}Ra activity and stable lead mass were associated with the dry deposition while the bulk of the ^{210}Pb activity was measured in the wet deposition.

18007 (EML—371, pp II.4-II.60) **Radioactivity in the lower stratosphere.** Leifer, R.; Toonkel, L.; Larsen, R. 1 Apr 1980.

In Environmental Measurements Laboratory environmental quarterly, December 1-March 1, 1980.

Project Airstream is a study of radioactivity and trace gases in the lower stratosphere employing the WB-57F aircraft as a sampling platform conducted by the Environmental Measurements Laboratory. The aircraft is flown by the National Aeronautics and Space Administration under the direction of the Johnson Space Center, Houston, Texas. This project is an outgrowth of the Defense Atomic Support Agency's Project Stardust with the first Airstream mission having been flown in August 1967. This report contains radioactivity data from the missions flown in October 1978, April 1979 and July 1979. Previous reports containing results from this program are given in references 1 through 35.

18008 (EML—371(App.)) **Appendix to Environmental Measurements Laboratory environmental quarterly.** Toonkel, L.E. (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Apr 1980. 364p. Dep. NTIS, PC A16/MF A01.

A description of the strontium 90 sampling network and available data for each site is presented. Data on the effects of changes in patterns of energy use on the chemical composition of wet and dry atmospheric precipitations and total deposition are recorded. The results of analyses of a number of fission and activation product radionuclides as well as trace elements from samples of airborne particles are presented. Separate abstracts are prepared for individual items in this appendix. (DC)

18009 (EML—371(App.), pp A.1-A.41) **Quarterly ^{90}Sr deposition at world land sites.** Toonkel, L.E. 1 Apr 1980.

In Appendix to Environmental Measurements Laboratory environmental quarterly.

The Environmental Measurements Laboratory (formerly the Health and Safety Laboratory) has carried out a ^{90}Sr fallout sampling program since the middle 1950's. This section presents the results of quarterly ^{90}Sr data at 77 sites beginning in 1976. Of the 77 sites for which quarterly data are reported, the monthly collections at 69 sites are composited and analyzed quarterly starting with the July 1976 samples. Data reported for the first half of 1976 at these sites as well as for the whole year at New York City and through June 1977 at the Australian sites, are quarterly results obtained by summing the monthly data. As of July 1977, the Australian sites have changed over to quarterly collection. The EML collections are

made using either high-walled stainless steel pots with exposed areas of 0.076 square meters or plastic funnels with exposed areas of 0.072 square meters to which are attached ion-exchange columns. A few sites which were established as part of a precipitation chemistry network use plastic pots with an area of 0.064 square meters for collection.

18010 (EML—371(App.), pp C.1-C.191) **Radionuclides and trace metals in surface air.** Feely, H.W.; Toonkel, L.E.; Larsen, R.J. 1 Apr 1980.

In Appendix to Environmental Measurements Laboratory environmental quarterly.

Since January 1963, The Environmental Measurements Laboratory (EML), formerly the Health and Safety Laboratory (HASL), has been conducting the Surface Air Sampling Program. This study is a direct outgrowth of a program initiated by the US Naval Research Laboratory (NRL) in 1957 and continued through 1962. The primary objective of this program is to study the spatial and temporal distribution of specific natural and man-made radioisotopes, and of trace metals in the surface air. Other special studies of surface air contamination have been performed during the course of the program.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

18011 (CONF-800516—1) **Atmospheric impacts of evaporative cooling systems.** Carson, J.E. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From 14. international symposium on atmospheric pollution; Paris, France (5 May 1980).

The observed atmospheric impacts resulting from the use of evaporative cooling systems are minor and usually environmentally acceptable. Although these impacts are also considerably smaller than those usually predicted a few years ago, regulatory agency requirements are such that these effects must be identified and quantified.

SITE RESOURCE AND USE STUDIES

18012 (CONF-7808115—) **Proceedings of the workshop on ionospheric and magnetospheric effects of Satellite Power Systems (SPS).** Rote, D.M. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 106p. Dep. NTIS, PC A06/MF A01.

From Workshop on ionospheric and magnetospheric effects of satellite power systems; Rosemont, IL, USA (28 Aug 1978).

The Workshop on Ionospheric and Magnetospheric Effects of Satellite Power Systems (SPS) was one of four workshops designed to provide guidance in the formation of a program to assess possible atmospheric effects of an SPS. The scope of the workshop was limited to atmospheric effects originating from the release of rocket propellant emissions into the ionosphere and magnetosphere. Atmospheric effects due to the release of rocket effluents in other portions of the atmosphere were dealt with in other workshops and the effects of the microwave power beam on the ionosphere is being treated as a separate task area. The approach used in the workshop resulted in a substantial amount of useful information, including: a listing of potentially important issues with assigned importance ratings; explanations of each issue and diagrams illustrating the interrelationships between the various SPS causes and identified potential atmospheric effects, and possible final impacts; recommendations for both short- and long-term research objectives; and recommended approaches to achieve those objectives. Along with this information, the present report also includes summaries of the informal presentations of the participants.

REGULATIONS

REFER ALSO TO CITATION(S) 17390

18013 (CONF-780744—3) **Air quality along the soft path: pollution and policy.** Streets, D.; Kung, S.L. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From 1. conference on energy and community development; Athens, Greece (10 Jul 1978).

The interplay between air quality control and the direction of energy development is discussed. The hard path of centralized, inefficient, high-technology methods of energy supply is compared with the soft path in which emphasis for energy supply is decentralization. The relationship between air quality and some of these soft path criteria is examined. How atmospheric emissions would be affected by pursuit of a soft future is discussed. Also, whether or not the regulatory structure in existence today tends to facilitate or impede the transition to such a future is covered. (DC)

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 17987, 17988, 18044, 18094

18014 **Litter fall from shrubs in the northern Majove Desert.** Strojan, C.L.; Turner,F.B.; Castetter, R. (Univ. of California, Los Angeles). *Ecology;* **60**: No. 5, 891-900(Oct 1979).

Plant litter was collected in traps from 8 to 10 replicates each of Ambrosia dumosa, Ephedra nevadensis, Krameria parvifolia, Larrea tradentata, Lycium andersonii, and Lycium pallidum in Rock Valley, southern Nevada, USA. Collections were made at biweekly to monthly intervals from 1975 to 1977 and handsorted into leaves, stems, flowers, and fruits. Litter fall was generally correlated with annual rainfall, which was low in 1975 (62 mm), high in 1976 (223 mm), and close to the longterm mean in 1977 (141 mm). Leaves were generally the largest litter category, followed by stems, fruits, and flowers. Large sample variations were found, particularly for reproductive parts. Aboveground litter fall from the six species, which comprise $\approx$ 82% of pernnial plant biomass and $\approx$ 81% of shrub cover in Rock Valley, was about 117 kg/ha in 1975 and 318 kg/ha in 1976. Total aboveground litter fall for Rock Valley (all perennial and annual plants) was estimated to be 194 kg/ha in 1975 and 530 kg/ha in 1976. Distinct litter fall patterns occurred for shrub species and litter categories. Most litter fell during the summer months, with individual species peaks reflecting particular phenologies. Significant amounts of live aboveground biomass were shed as litter. Amounts of litter from the six species ranged from 7 to 83% of their respective live aboveground biomass.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18094

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18002

SOIL

REFER ALSO TO CITATION(S) 17436, 17439, 18004

18015 (EML—371, pp I.59-I.89) **Concentrations of eighteen trace elements in a dated sediment core from Standley Lake, CO.** Heit, M. (Dept. of Energy, New York, NY); Klusek, C.; Volchok, H.; Burke, J. 1 Apr 1980.

In Environmental Measurements Laboratory environmental quarterly, December 1-March 1, 1980.

A depositional history, 1961 to 1976, of eighteen trace elements is described for Standley Lake, a reservoir 16 km northwest of Denver, CO. The elements were measured in sediment sections from a 50 cm long core which had been dated using ^{137}Cs. Concentrations of Ag, Cd, Cu, Hg, Pb, Se and Zn increased with depth while concentrations of Al, As, Co, Cr, Ga, Ni, Sn and V remained fairly constant. The trends of Tl and Be with depth are unclear while Te was not detected in any of the samples. The concentrations of Ag, Cd, Pb and Zn were found to be comparable to levels reported for sediment from water bodies located in industrialized zones. The Zn concentrations were particularly high (1100-3400 $\mu g/g$ dry weight) approaching levels reported for sediment from mining areas. The origin of these elements in the lake sediment is discussed from the viewpoints of enrichment factors, comparison with the elemental levels in other lakes, correlation coefficients, flux, and benzo(a)pyrene concentrations.

18016 (ORNL—5448) **Assessment of the radiological impact of the inactive uranium-mill tailings at Mexican Hat, Utah.** Haywood, F.F.; Goldsmith, W.A.; Ellis, B.S.; Hubbard, H.M. Jr.; Fox, W.F.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 95p. Dep. NTIS, PC A05/MF A01.

High surface soil concentrations of ^{226}Ra and high aboveground measurements of gamma-ray intensity in the vicinity of the

inactive uranium-mill tailings at Mexican Hat show both wind and water erosion of the tailings. The former mill area, occupied by a trade school at the time of this survey, shows a comparatively high level of contamination, probably from unprocessed ore on the surface of the ore storage area near the location of the former mill buildings. However, the estimated health effect of exposure to gamma rays during a 2000-hr work year in the area represents an increase of 0.1% in the risk of death from cancer. Exposure of less than 600 persons within 1.6 km of the tailings to radon daughters results in an estimated 0.2%/year increase in risk of lung cancer.

18017 (ORNL—5451) **Radiological survey of the inactive uranium-mill tailings at Durango, Colorado.** Haywood, F.F.; Perdue, P.T.; Shinpaugh, W.H.; Ellis, B.S.; Chou, K.D. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 93p. Dep. NTIS, PC A05/MF A01.

Results of a radiological survey of the inactive uranium-mill site at Durango, Colorado, conducted in April 1976, in cooperation with a team from Ford, Bacon and Davis Utah Inc., are presented together with descriptions of the instruments and techniques used to obtain the data. Direct above-ground gamma measurements and analysis of surface soil and sediment samples indicate movement of tailings from the piles toward Lightner Creek on the north and the Animas River on the east side of the piles. The concentration of ^{226}Ra in the former raffinate pond area is only slightly above the background level. Two structures in Durango were found to contain high concentrations of airborne radon daughters, where tailings are known to have been utilized in construction. Near-background concentrations of radon daughters were found in a well-ventilated building close to the tailings.

18018 (ORNL—5453) **Radiological survey of the inactive uranium-mill tailings at Gunnison, Colorado.** Haywood, F.F.; Jacobs, D.G.; Hubbard, H.M. Jr.; Ellis, B.S.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 79p. Dep. NTIS, PC A05/MF A01.

The findings of a radiological survey of the inactive uranium-mill site at Gunnison, Colorado, conducted in May 1976, are presented. Results of surface soil sample analyses and direct gamma radiation measurements indicate limited spread of tailings off the site. The only significant above background measurements off the site were obtained in an area previously covered by the tailings pile. There was little evidence of contamination of the surface or of unconfined groundwater in the vicinity of the tailings pile; however, the hydrologic conditions at the site indicate a potential for such contamination. The concentration of ^{226}Ra in all water samples except one from the tailings pile was well below the concentration guide for drinking water. The subsurface distribution of ^{226}Ra in 14 bore holes located on and around the tailings pile was calculated from gamma ray monitoring data obtained jointly with Ford, Bacon and Davis Utah Inc.

18019 (ORNL—5456) **Radiological survey of the inactive uranium-mill tailings at Maybell, Colorado.** Haywood, F.F.; Perdue, P.T.; Ellis, B.S. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 70p. Dep. NTIS, PC A05/MF A01.

Results of a radiological survey of the inactive uranium-mill tailings near Maybell, Colorado are presented. Measurements of external gamma exposure rate at 1 m above the tailings ranged 16 to 340 μR/hr with an average value of 65 μR/hr. Radionuclide analysis of offsite soil and sediment samples, as well as above-ground gamma exposure rate measurements defined the spread of contamination around the tailings pile. This spread is greatest toward the east, in the direction of surface water runoff. Calculated concentrations of ^{226}Ra in all of the holes drilled in the tailngs, based on gamma monitoring data, showed maximum concentrations in the range 100 to 800 pCi/g.

18020 (ORNL—5459) **Radiological survey of the inactive uranium-mill tailings at Green River, Utah.** Haywood, F.F.; Christian, D.J.; Ellis, B.S.; Hubbard, H.M. Jr.; Lorenzo, D.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 71p. Dep. NTIS, PC A04/MF A01.

The uranium-mill tailings at Green River, Utah, are relatively low in ^{226}Ra content and concentration (20 Ci and 140 pCi/g, respectively) because the mill was used to upgrade the uranium ore by separating the sand and slime fractions; most of the radium was transported along with the slimes to another mill site. Spread of tailings was observed in all directions, but near-background gamma exposure rates were reached at distances of 40 to 90 m from the edge of the pile. Water erosion of the tailings is evident and, since a significant fraction of the tailings pile lies in Brown's Wash, the potential exists for repetition of the loss of a large quantity of tailings such as occurred during a flood in 1959. In general, the level of surface contamination was low at this site, but some areas in the mill site, which were being used for nonuranium work, have gamma-ray exposure rates up to 143 μR/hr.

18021 (ORNL—5461) **Radiological survey of the inactive uranium-mill tailings at Riverton, Wyoming.** Haywood, F.F.; Lorenzo, D.; Christian, D.J.; Chou, K.D.; Ellis, B.S.; Shinpaugh, W.H. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 60p. Dep. NTIS, PC A04/MF A01.

Results of a radiological survey performed at the Riverton, Wyoming site in July 1976, are presented. The average external gamma exposure rate at 1 m over the tailings pile was 56 μR/hr. The corresponding rate for the former mill area was 97 μR/hr. Movement of tailings particles in a dry wash is evident; but it appears that, in general, the earth cover over the tailings pile has been effective in limiting both wind and water erosion of the tailings. The calculated concentration of ^{226}Ra as a function of depth in 15 augered holes is presented graphically. A survey of the Teton Division Lumber Company property in Riverton showed a maximum external gamma exposure rate of 270 μR/hr.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 17439

SITE RESOURCE AND USE STUDIES

18022 **Simulating industrial location to minimize energy costs.** Sears, J.T. (West Virginia Univ., Morgantown); Padgett, L.R. pp 571 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A linear programming model has been constructed to determine the optimal regional distribution of industry in the 48 contiguous states to minimize energy costs for production and transportation. A projected vector of regional final demand was met for each industry; energy balances were maintained for each region of the country; material balances were maintained for each industry in each region of the country; and limits on the regional size of resource-based industry depended on a region's resources.

ENVIRONMENTAL SCIENCES, AQUATIC

18023 **Neutralization options for acid mine drainage control.** Wilmoth, R.C.; Martin, J.F. (Environmental Protection Agency, Cincinnati, OH). pp 531-536 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper outlines methods for acid mine drainage control. Surface mine situations and deep mine situations are discussed. The following treatments are summarized: at source lime treatment; sodium carbonate treatment; sodium hydroxide treatment; limestone treatment; and combination limestone-lime treatment.

BASIC STUDIES

REFER ALSO TO CITATION(S) 17987, 17988, 18075, 18094, 18095

18024 **Reactions of chlorine, chlorine dioxide, and mixtures thereof with humic acid: an interim report.** Noack, M.G.; Doerr, R.L. (Olin Research and Development Center, New Haven, CT). pp 49-58 of Water chlorination: environmental impact and health effects. Volume 2. Jolley, R.L.; Gorchev, H.; Hamilton, D.H. Jr. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978).

From Conference on water chlorination: environmental impact and health effects; Gatlinburg, TN, USA (31 Oct 1977).

Models are being developed for the chemistry of disinfecting drinking water with chlorine and chlorine dioxide in the presence of the model humic acid. This report deals with kinetics, oxidant demand, and formation of toxic reaction products. (PCS)

18025 (DOE/EV/00889—6) **Continental shelf processes affecting the oceanography of the South Atlantic Bight. Progress report, June 1, 1979-May 31, 1980.** Atkinson, L.P. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 29 Feb 1980. Contract AS09-76EV00889. 9p. Dep. NTIS, PC A02/MF A01.

Progress is reported on research conducted from June, 1979 to May, 1980 on various oceanographic aspects of the South Atlantic

Bight. Research topics included: (1) A flashing model of Onslow Bay, North Carolina based on intrusion volumes; (2) A description of a bottom intrusion in Onslow Bay, North Carolina; (3) Detailed observations of a Gulf Stream spin-off eddy on the Georgia continental shelf; (4) Pelagic tar of Georgia and Florida; (5) A surface diaton bloom in response to eddy-forced upwelling; and (6) Hydrographic observations off Savannah and Brunswick, Georgia.

18026 (DP-MS—79-107) **Primary production and biovolume of chroococcoid cyanobacteria in relation to other phytoplankton in southeastern US lakes.** Tison, D.L.; Wilde, E.W. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Biology; Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1979. Contract EY-76-C-09-0001. 12p. (CONF-800132—1). Dep. NTIS, PC A02/MF A01.

From American Society of Limnology and Oceanography winter meeting; Los Angeles, CA, USA (31 Jan 1980).

Primary production rates and algal biovolumes were measured for various size classes of phytoplankton in three South Carolina lakes. Size classes of less than 3 μm accounted for 15 to 40% of the total primary production but only represented less than 5% of the total algal biovolume. Fluorescence microscopic analyses and laboratory culturing experiments indicated that chroococcoid cyanobacteria (unicellular blue-green algae) were primarily responsible for the relatively high primary production rates by the less than 3-μm component of the phytoplankton.

18027 **Composition, abundance, and distribution of zooplankton in the New York Bight, September 1974-September 1975.** Judkins, D.C. (Brookhaven National Lab., Upton, NY); Wirick, C.D.; Esaias, W.E. *Fish. Bull.;* 77: No. 3, 669-683(Jul 1979).

Zooplankton taxa were counted in 8 to 19 samples from each of 11 cruises in the New York Bight between September 1974 and September 1975. Major seasonal events were an influx into the region of tropical-subtropical copepod species during autumm 1974 and summer 1975, an offshore (> 50 m water depth) zooplankton abundance maximum in March dominated by the pteropod Limacina retroversa, a second offshore maximum in May characterized by high abundance of the copepods Pseudocalanus sp, Calanus finmarchicus, and Oithona similis, and an offshore (> 50 m water depth) maximum in July characterized by high abundance of the copepods Centropages typicus and Temora longicornis. The offshore maxima occurred during or shortly after the local spring phytoplankton bloom (March-April). Advection of pteropod and copepod stocks into the region from the northeast probably contributed to these peaks. The July C. typicus-T. longicornis peak was associated with summer warming of the water column within the highly productive waters in the Bight apex and off the New Jersey coast. Comparison of our results with those of a study conducted in 1959-1960 shows that the most abundant species of copepods were essentially the same during the two periods.

18028 **Developing a hydrologic model of the shallow aquifers of the Powder River Basin, Montana and Wyoming.** Hotchkiss, W.R. (Geological Survey, Helena, MT). pp 212-217 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buoniconre, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The US Geological Survey is presently constructing a hydrologic model of the shallow aquifers in the Powder River Basin of Montana and Wyoming. This area contains strippable coal reserves exceeding 45 billion tons in Tertiary deposits. Increased coal development will place heavy demands on the limited surface- and ground-water resources of the area. Therefore, greater quantification of the hydrology of the basin is becoming increasingly important to decisions regarding resource development. The model will simulate five aquifers within the stratigraphic interval which includes the Upper Cretaceous Fox Hills Sandstone and Hell Creed Formation and the Tertiary Fort Union and Wasatch Formations. The model will initially be used in an attempt to simulate steady-state or premining hydrologic conditions in the basin. Ultimately, the model will be used in an attempt to simulate the broad hydrologic response to stress imposed by development of proposed mining sites under various alternative development plans and water-use contraints.

18029 **Water quality and ecological studies in the TVA site evaluation and assessment program.** Brooks, R.H.; Urban, R.D.; Isom, B.G. (Tennessee Valley Authority, Chattanooga). pp 339-343 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The Tennessee Valley Authority (TVA) designs its water quality and ecological studies to meet the needs of its planning process and to ensure proper evaluation of the potential environmental impacts of its projects and activities. For example, TVA's general strategy for compliance with the National Environmental Policy Act involves developing and implementing appropriate procedures for including consideration of environmental factors, such as water quality and ecology, in the TVA planning and decision process. Water quality and aquatic biological assessments conducted in support of TVA's program for assessing and selecting potential sites for new power plants are conducted in four phases, as are other assessments. The first phase involves a general assessment of a region where the existence of potentially suitable sites is considered to be likely. In the second phase, the general information gathered in the first phase is reexamined and evaluated in relation to specific sites within the region. In the third phase, detailed baseline studies of these sites are begun, and the most promising sites are recommended for acquisition and placed in a site inventory. In the fourth phase, baseline studies are completed, and information needed to support project licensing and permitting actions is documented.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 17361, 18094

18030 **Ozone, chlorine dioxide and chloramines as alternatives to chlorine for disinfection of drinking water.** Symons, J.M. (comp.). (Environmental Protection Agency, Cincinnati, OH). pp 555-560 of Water chlorination: environmental impact and health effects. Volume 2. Jolley, R.L.; Gorchev, H.; Hamilton, D.H. Jr. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978).

From Conference on water chlorination: environmental impact and health effects; Gatlinburg, TN, USA (31 Oct 1977).

Comparative disinfectant properties are discussed for ozone chlorine dioxide, and chloramines as possible chlorine replacements. Parameters considered were biocidal activity, measurement, and persistence of residual chemical byproducts, cost, and health hazards. (PCS)

18031 **TVA programs in environmental effects of energy systems.** Hickey, H.R. (Tennessee Valley Authority, Chattanooga). pp 18-23 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The paper presents a summary of TVA's research projects on energy effects. The program is well controlled through a simple and practical technical, financial, and legal protocol and is beginning to produce important results.

18032 **Textile processing with trichlorotrifluoroethane.** Mader, F.W.; Ramsey, R.B. (E.I. Du pont de Nemours, Wilmington, DE). pp 37-42 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Solvent processing for removal of oil from knits has been commercialized by the textile industry. The economic justification is primarily based on improved product yield and reduced water pollution. A simultaneous reduction in energy requirements of 90% is achieved over both aqueous and competitive solvent scouring processes using the nonpolar solvent, trichlorotrifluoroenthane. The low boiling point and heat of vaporization for this solvent permit achieving the significant energy reduction, since the scouring can be performed in the absence of air under 1-atm vapor pressure of the solvent. Also, the low boiling point permits recovery of the oils at a purity level suitable for recycle or mixing with plant fuel oil used for raising steam.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18002

WATER

REFER ALSO TO CITATION(S) 17436, 17439, 17447, 18004

AQUATIC ECOSYSTEMS AND FOOD CHAINS

18033 (PNL—3269) **Decline of radionuclides in Columbia River biota.** Cushing, C.E.; Watson, D.G.; Scott, A.J.; Gurtisen, J.M.

(Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract EY-76-C-06-1830. 28p. Dep. NTIS, PC A03/MF A01.

In January 1971, the last of nine plutonium production reactors using direct discharge of once-through cooling waters into the Columbia River was closed. Sampling was initiated at three stations on the Columbia River to document the decline of the radionuclide body burdens in the biota of the Columbia River ecosystem. The data show that in a river-reservoir complex, the measurable body burden of fission-produced radionuclides decreased to essentially undetectable levels within 18 to 24 mo after cessation of discharge of once-through cooling water into the river. On the basis of data from the free-flowing station, we believe that this decrease would be even more rapid in an unimpounded river.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 18026, 18077

18034 (EPRI-EA—1148(Vol.2)) **Evaluation of a cooling lake fishery. Volume 2. Lake Sangchris ecosystem modeling. Final report.** Larimore, R.W.; McNurney, J.M.; Halffield, D.R. Jr. (Illinois Natural History Survey, Urbana (USA)). Nov 1979. 218p. Dep. NTIS, PC A10/MF A01.

Volume 2 is a description of the Lake Sangchris ecosystem modeling experience with a discussion of the theories, supportive data, and mathematical formulations used in development of the models. The structure and function of each of the resulting two major systems of differential equations, the physical model (TEMP) and the mainly biological Cooling Lake Ecosystem Model (CLEM), are fully documented TEMP is a relatively simple model of Lake Sangchris that computes temperature and changes in water volume in shallow and deep water areas of each of four large sections of the lake. The calculations are based on energy and mass inputs and losses and the results, along with some meteorological data, become the forcing functions of CLEM. CLEM is comprised of a series of submodels that define phosphorus, detritus, phytoplankon, periphyton, macrophyton, zooplankton, benthos, and fish dynamics. Mass is conserved within and between compartments. Transfers are generally food-consumer interactions, mortality, and recruitment. Numbers are also conserved in the fish submodel. Physiological processes provide the primary level of description in CLEM. Tests of various parts of TEMP and CLEM and comphrehensive tests of each total system were used to validate the models and to test their analytical responses.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 18029, 18034

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 18038

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 17368, 17371, 17996

18035 **Energy and the environment. Proceedings of the fifth national conference.** Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978). 607p. (CONF-7710101—).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The meeting was held to explore and emphasize the critical nature of an energy-environmental and economic balance and those factors that influence this relationship. Sessions dealt with energy conservation; waste disposal, control, and utilization; methodology for assessment studies; energy system studies; air pollution control; coal preparation and cleaning; alternate energy sources; regional analysis; socio-economic impacts;water pollution control; and general environmental studies.

18036 **Ohio River Basin energy study.** Smith, L. (Environmental Protection Agency, Washington, DC). pp 361-373 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

The ORBES project to date has primarily been an issue-raising activity, an effort to broadly scope out the possible questions and problems related to an accelerating rate of power plant development in the Ohio River basin. Principal among these problem areas identified to date is that of air quality degredation. Water availability for all projected and anticipated uses may become a problem in the future. Coal extraction activities could degrade land quality and productivity for local areas, or produce other land-use conflicts, especially with agriculture in Illinois. Certain coal mining practices could, if uncontrolled, continue to create water quality problems for decades to come. Some local discomfort from a rapid expansion of construction activities may be experienced in communities remote from experienced labor pools. The desire for and pursuit of the good life on the part of many residents in the region is in part responsible for creating the current power plant development activity. It is this same activity which has stimulated many citizens' concerns about how permanent their good life is likely to be. Understanding the dynamics which create these paradoxes is a necessary step in bringing about their resolution. ORBES' goal is to increase that understanding among all affected parties.

18037 **Some contingencies and errors in environmental impact statements (EIS) and social impact assessments (SIA).** Piccagli, G.; Thompson, J.G. (Univ. of Wyoming, Laramie). pp 487-494 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This paper has several clear implications for research, decision making and planning strategy in impact situations. This research should be of such a nature as to concentrate on the improvement of present techniques and be undertaken in such a manner as to yield exportable results. Secondly such research must be of a longitudinal, empirical nature - rather than an a priori, largely conjectural procedure. At the same time, the comprehensiveness of costing must be increased in such research and more accurate costing methods applied. Third, the decision to proceed should not be an ex ante once-and-for-all decision, with no subsequent attention paid to the specific situation. Rather, and particularly in situations where the decision is strongly arguable, a socio-economic monitoring system should be established. This will allow rational adjustment of the situation as various effects, and particularly problems, become manifest. Such a procedure has already been used in some states and should be generalized. The implementation of such monitoring systems should be accompanied by the exploration of various strategies to effect change once problems arise. One such strategy is the establishment of contingency funds as preconditions of approval for individual projects.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 17367, 17391

18038 **Managing the socioeconomic impacts of energy development: present practice and future promise.** Edelston, B.S. (Charles River Associates Inc., Cambridge, MA). pp 132-137 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

This article points out the need for and application of socio-economic impact assessment tools. Before such tools become of practical use to government planners, more research must be done on refining the inputs and components of impact assessment models. It is hoped models will be refined so that they have practical applications in managing the socioeconomic impacts of energy development.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 17456

18039 (CONF-7906152—1) **Mental disorders and consanguinity comparison of first-cousin marriages and matched unrelated marriages.** Helgason, T. (Iceland Univ., Reykjavik). 1979. Contract EY-76-C-02-3214. 14p. Dep. NTIS, PC A02/MF A01.

From Symposium on epidemiological problems in genetics; Reykjavik, Iceland (Jun 1979).

Mental disorders have long been known to run in families. How and why has still not been agreed upon. However, most psychiatrists probably agree that there is no unitary cause, either environmental or hereditary, for the common mental disorders. In each case a number of etiological factors are at work to a variable extent, social, psychological, biochemical and pathophysiological. These include hereditary mechanism, such as predisposition which under certain stress (Rosenthal 1970) can result in a disease. The present paper is intended to give some additional data for the further discussion of the issues involved. It is a part of a larger study of first-cousin marriages and their children. The purpose of this larger study is to investigate various genetic markers among these families as well as their fertility, morbidity and mortality. Here the occurrence of mental disorders in these families will be analyzed and compared with that in the general population. If recessive hereditary traits are involved in the etiology of mental disorders an increased frequence should be expected among children of such families.

18040 (P—173) **Human interaction with the physical environment: patterns of living, socialization, behavior, and environmental cognition in various cultures. Selected annotated bibliography.** Maltz, N.J. (City Univ. of New York, NY (USA). Graduate Center). Feb 1979. 30p. Vance Bibliographies, P.O. Box 229, Monticello, IL.

Bibliographies are included for the following subjects: lifestyles in various cultures; cross-cultural interaction and contact; cognition and social behavior in various settings and cultures; cultural views and attitudes; historical views; cultural influences on behavior; processes in socialization and education, social and individual development of children and adolescents; human adaption to environment; relationship of human-made environments to human needs and behavior; public policy and human needs; neighborhood and neighborhood organization; urban structure and character; and community. (DC)

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 18050, 18078, 18080, 18087

18041 (DOE/EV/00643—15) **RNA metabolism in the regulation of protein synthesis in plants. Progress report, 1975-1979.** Key, J.L. (Georgia Univ., Athens (USA). Dept. of Botany). 1979. Contract EY-76-S-09-0643. 7p. Dep. NTIS, PC A02/MF A01.

The major objectives of the research for the contract period covered by this report were (1) to gain an insight into the sequence organization of the DNA of soybean, emphasizing the arrangement of single copy or unique sequences and repetitive sequences of DNA throughout the genome, (2) to characterize soybean RNAs relative to nucleotide sequence complexity and kinetics of synthesis and turnover of poly A^+ mRNA, and (3) to study ribosomal proteins directed to an analysis of possible changes in proteins which relate to the activation of 80S ribosomes and thus mRNA utilization and protein synthesis in response to environmental stimuli. Even with greatly reduced funding compared to that requested, objectives 1 and 2 were substantially accomplished. Because of reduced funding and the 20-month no cost extension, relatively little progress was made on objective 3. Accordingly objectives 1 and 2 will be summarized in some detail; a brief account of progress is presented on objective 3.

18042 (DOE/TIC—10285) **Nucleosome structure and conformational states.** Bryan, P.N. (Tennessee Univ., Knoxville (USA)). Aug 1979. Contract EY-76-C-05-0033. 152p. Dep. NTIS, PC A08/MF A01.

Thesis.

The study of chromatin and nucleosomes by biochemical and biophysical methods is described. The techniques used include circular dichroism, thermal denaturation, analytical ultracentrifugation, nuclease digestion pattern, and electron microscopy. The effect of urea on the structure of nucleosomes and chromatin was studied. It was found that there are two domains in the nucleosome which respond differently to urea. The observation that different domains of the nucleosome exhibited different responses to urea offers a basis for viewing the altered conformation of transcriptionally active chromatin. Modulations of the DNA-rich shell by nonhistone proteins or histone modifications might occur with only minor alterations in the conformation of the protein-rich core, permitting rapid renaturation to the transcriptionally inactive chromatin configuration. In order to study the effect of DNA sequence and base composition on nucleosomal strcture, histone-DNA complexes containing histones (H2A, H2B, H3, H4) and a variety of DNAs, including synthetics, were reconstructed. The properties of the reconstructed complexes were similar to those of H1- and H5-depleted chromatin. Monomer nucleosomes were homogeneous with respect to DNA length and exhibited clear nucleosomal structure. It was possible to obtain good reconstruction between chicken erythrocyte inner histones and DNA of a wide variety of G + C%.Nucleosomes containing poly(dA-dT) gave detailed information about the internal structure of nucleosomes. The nucleosome appeared to have two domains of DNA differing in secondary structure. Nucleosomes containing poly(dA-dT) were also sensitive indicators of conformation changes in structure due to temperature and ionic strength.

18043 (DOE/TIC—11134) **Chronon theory of rhythm control.** Ehret, C.F. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

The chronon theory of circadian rhythm control attributes the circadian oscillation to a phylogenetically general and structurally fundamental regulatory property of eukaryotic gene-action systems: the organization of the genetic material into polygenic sequences or chronons which require about a day for a strictly programmed chronotypic series of gene products to appear. By virtue of their naturally selected fixed length and net transcription velocity, the chronons define the length of the period of infradian cells to be circadian; a chronon recycling component assures reinitiation of circadian cycles so long as infradian conditions persist.

18044 **Watering converts a CAM plant to daytime CO_2 uptake.** Hartsock, T.L.; Nobel, P.S. (Univ. of California, Los Angeles). *Nature (London)*; **262**: No. 5569, 574-576(12 Aug 1976).

Many succulent plants growing in arid regions utilize the crassulacean acid metabolism (CAM) photosynthetic pathway to incorporate CO_2. The effect of giving CAM plants an adequate water supply, obviating the need for water conservation, is investigated. It is shown that this leads to their conversion to daytime CO_2 uptake. (ACR)

TRACER TECHNIQUES

18045 **Analysis by low-angle neutron scattering of the structure of the acetylcholine receptor from Torpedo californica in detergent solution.** Wise, D.S. (Columbia Univ., New York); Karlin, A.; Schoenborn, B.P. *Biophys. J.*; **28**: No. 3, 473-496(Dec 1979).

The acetylcholine receptor from the electric tissue of Torpedo californica is a large, integral membrane protein containing four different types of polypeptide chains. In this paper the results of the use of low-angle neutron scattering to investigate the shape of the receptor-detergent complex and separately of its protein and detergent moieties are reported. By adjustment of the neutron-scattering density of the solvent with D_2O to match that of one or the other of the moieties, its contribution to the scattering can be nearly, if not completely, eliminated. Neutron scattering from Triton X-100 micelles established that this detergent is contrast matched in 18% D_2O. Scattering measurements on the receptor-detergent complex in this solvent yielded a radius of gyration of the acetylcholine receptor monomer of 46 +- 1 A. The radius of gyration and molecular volume (305,000 A^3) of the receptor is inconsistent with a compact spherical shape. These parameters are consistent with, for example, a prolate cylinder of dimensions (length x diameter) 150 x 50 A or an oblate cylinder, 25 x 130 A. More complex shapes are possible and in fact seem to be required to reconcile the present results with previous electron microscopic and x-ray analyses of receptor in membrane and with considerations of the function of the receptor in controlling ion permeability. The neutron-scattering data yield, in addition, an independent determination of the molecular weight of the receptor protein (240,000 +- 40,000), the extent of Triton X-100 binding in the complex (0.4 g/g protein), and from the extended scattering curve, an approximation to the shape of the receptor-Triton X-100 complex, namely an oblate ellipsoid of axial ratio 1:4.

CYTOLOGY

REFER ALSO TO CITATION(S) 18092

18046 **Subcellular distribution of gluconeogenetic enzymes in germinating castor bean endosperm.** Nishimura, M.; Beevers, H. (Univ. of California, Santa Cruz). Contract EY-76-03-0034. *Plant Physiol.*; **64**: No. 1, 31-37(Jul 1979).

The intracellular distribution of enzymes capable of catalyzing the reactions from oxaloacetate to sucrose in germinating castor bean endosperm has been studied by sucrose density gradient centrifugation. One set of glycolytic enzyme activities was detected in the plastids and another in the cytosol. The percentages of their activities in the plastids were less than 10% of total activities except for aldolase and fructose diphosphatase. The activities of several of the enzymes present in the plastids seem to be too low to account for

the in vivo rate of gluconeogenesis whereas those in the cytosol are quite adequate. Furthermore, phosphoenolypyruvate carboxykinase, sucrose phosphate synthetase, and sucrose synthetase, which catalyze the first and final steps in the conversion of oxaloacetate to sucrose, were found only in the cytosol. It is deduced that in germinating castor bean endosperm the complete conversion of oxaloacetate to sucrose and CO_2 occurs in the cytosol. The plastids contain some enzymes of the pentose phosphate pathway, pyruvate dehydrogenase and fatty acid synthetase in addition to the set of glycolytic enzymes. This suggests that the role of the plastid in the endosperm of germinating castor bean is the production of fatty acids from sugar phosphates, as it is known to be in the endosperm during seed development.

18047 Content and vacuole extravacuole distribution of neutral sugars, free amino acids, and anthocyanin in protoplasts. Wagner, G.J. (Brookhaven National Lab., Upton, NY). *Plant Physiol.;* **64**: No. 1, 88-93(Jul 1979).

Neutral sugar, free amino acid, and anthocyanin levels and vacuole/extravacuole distribution were determined for Hippeastrum and Tulipa petal and Tulipa leaf protoplasts. Glucose and fructose, the predominant neutral monosaccharides observed, were primarily vacuolar in location. Glutamine, the predominant free amino acid found, was primarily extravacuolar. γ-methyleneglutamate was identified as a major constituent of Tulipa protoplasts. Qualitative characterization of Hippeastrum petal and vacuole organic acids indicated the presence of oxalic, malic, citric, and isocitric acids. Data are presented which indicate that vacuoles obtained by gentle osmotic shock of protoplasts in dibasic phosphate have good purity and retain their contents.

MEDICINE

REFER ALSO TO CITATION(S) 18088

EXTERNAL RADIATION IN THERAPY

18048 (CONF-7909122—1) **Experience with high-energy electron beam therapy at the University of Chicago.** Griem, M.L.; Kuchnir, F.T.; Lanzl, L.H.; Skaggs, L.S.; Sutton, H.G.; Tokars, R. (Chicago Univ., IL (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, IL (USA)). 1979. Contract EY-76-C-02-0069. 20p. Dep. NTIS, PC A02/MF A01.

From Symposium on electron beam therapy; New York, NY, USA (25 Sep 1979).

Current utilization of the linear accelerator as well as 5-year cumulative experience in radiotherapy is presented. Cutaneous lymphomas and mammary gland carcinomas were the prime experience region; however, cancers at other locations were treated with mixed-beam therapy; employing fast neutrons and photon beams. The technique appears promising for abdominal tumors and deep-seated malignancies. Carcinoma of the pancreas responds favorably to this technique. (PCS)

MICROBIOLOGY

REFER ALSO TO CITATION(S) 17473, 17474, 18079

18049 (LBL—10435) **Small scale mass culture of Daphnia magna Straus.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1980. Contract W-7405-ENG-48. 17p. (CONF-800333—1). Dep. NTIS, PC A02/MF A01.

From 11. annual meeting of the World Mariculture Society; New Orleans, LA, USA (3 Mar 1980).

Daphnia magna Straus 1820 was raised on a defined medium in 4-liter flasks with controlled light intensity, temperature, and algal food species. Adult D. magna tolerated high levels of ammonia (up to 108 μM) at high pH (> 10), although at these levels parthenogenic reproduction may be inhibited. Scenedesmus quadricauda and Ankistrodesmus sp. were satisfactory food sources, and by utilizing Ankistrodesmus densities greater than one animal per ml were achieved. Maintaining the pH at about 7 to 8 seems to be important for successful D. magna culture.

18050 Diel changes in phased-dividing cultures of Ceratium furca (dinophyceae): nucleotide triphosphates, adenylate energy charge, cell carbon, and patterns of vertical migration. Weiler, C.S.; Karl, D.M. (Univ. of California, San Diego, La Jolla). *J. Phycol.;* **15**: No. 4, 384-391(Dec 1979).

The diel pattern of cell division, cell carbon, adenine nucleotides and vertical migration was determined for laboratory cultures of the photosynthetic marine dinoflagellate, Ceratium furca (Ehr.) Clap. and Lachm., entrained on an alternating 12:12 LD schedule at 20 C. Cell division was initiated during the latter portion of the dark period with ca. 30% of the population undergoing division. Cell C increased during the light period and exhibited a linear decrease with a loss of 33% during the dark period. ATP . $cell^{-1}$ increased during the light period and decreased by Ca. 40 to 50% during the dark period. The diel patterns of cell C and ATP tended to buffer the magnitude of the change in C:ATP ratios around an overall mean value of 89. There was no obvious trend in the concentration of [GTP + UTP] . $cell^{-1}$ over the cell cycle. The cellular adenylate energy charge was maintained at values between 0.8 to 0.9 throughout the 24 h LD cycle, despite a ca. 40% decrease in total adenylates (A/sub T/ = ATP + ADP + AMP) during the dark period on 12:12 LD, and over a 68% decrease in ATP during 42 h of continuous darkness. These data lend experimental support to the theory of cellular metabolic control by the adenine nucleotides. With lateral illumination on 12:12 LD cycles, the cells began to concentrate at the surface of the experimental tubes shortly before the lights were turned on, and at the bottom of the tubes shortly before the lights were extinguished. This patterncontinued for 6 days in continuous darkness, suggesting that the vertical migration pattern is independent of a phototactic response and may be under the control of an endogenous rhythm.

18051 Superoxide involvement in the bactericidal effects of negative air ions on Staphylococcus albus. Kellogg, E.W. III (Univ. of California, Berkeley); Yost, M.G.; Barthakur, N.; Kreuger, A.P. *Nature (London);* **281**: No. 5730, 400-401(4 Oct 1979).

The physical nature of small air ions is well established and it is recognized that they can produce a variety of biological effects. However, in only a few instances have any underlying biochemical changes been detected. Theoretically, one can consider the hydrated superoxide radical anion (O_2^-) (H_2O)/sub n/ with n = 4 to 8 as a likely candidate for a biologically active species of negative air ion. The chemical and biological reactivity of superoxide is high and includes a leading role in bacterial killing caused by radiation, in which superoxide dismutase (SOD), an enzyme that catalyses the reaction: $O_2^- + O_2^- + 2H \rightarrow H_2O_2 + O_2$ protected markedly. Other studies have also demonstrated the bactericidal effect of O_2^-. Inasmuch as the bactericidal action of small negative air ions has been repeatedly confirmed, we decided to test for the involvement of O_2^- in this phenomenon by evaluating the protective effect of SOD. Results show strong O_2^- involvement in negative air ion bacterial kill.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 18080

MORPHOLOGY

REFER ALSO TO CITATION(S) 18046

18052 Isolation and characterization of the protein body membrane of castor beans. Mettler, I.J.; Beevers, H. (Univ. of California, Santa Cruz). Contract EY-76-5-03-0034. *Plant Physiol.;* **64**: No. 3, 506-511(Sep 1979).

Intact protein bodies were isolated from dry castor bean seeds (Ricinus communis L.) after homogenization in nonaqueous medium. After repeated washing with glycerol to remove trapped lipid globules, the soluble matrix proteins were removed by the addition of aqueous buffer. The membrane remained attached to the insoluble protein crystalloids and was subsequently released by sonication. Purification of the membrane vesicles in a sucrose gradient produced a single band at a density of 1.21 grams per cubic centimeter. Treatment with 6 molar urea, 1 molar KCl, or 0.25 molar galactose had no effect on the equilibrium density of the membrane. Electron microscopy revealed a highly pure and uniform collection of membrane vesicles. No enzyme activity was specifically associated with the membrane. Sodium dodecyl sulfate gel electrophoresis of the protein body fractions showed that the membrane contained unique proteins, two of which were glycosylated. The membrane contained 153 nanomoles of phospholipid per milligram of protein. The composition of the phosphoglycerides was 51% ethanolamine, 41% choline, 8% inositol, and a trace of serine.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 18085

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 18046, 18050, 18055

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 18085

18053 Amino acids translocated from turgid and water-stressed barley leaves. I. Phloem exudation studies. Tully, R.E.; Hanson, A.D. (Michigan State Univ., East Lansing, MI). Contract EY-76-C-02-1338. *Plant Physiol.;* **64**: No. 3, 460-466(Sep 1979).

A phloem exudation technique was modified for use with barley plants, to investigate the effect of water stress upon amino acid translocation at seedling and grain-filled stages. Seedling leaves and flag leaves from unstressed and moderately water-stressed plants exuded $^{14}CO_2$ assimilates, sugars, and amino acides when their sheaths were cut and immersed in a 5 millimolar solution of Na_2EDTA (pH 7.0). By including PEG 6000 (- 10 bars) in the Na_2EDTA solution, leaves severed from moderately water-stressed plants could be maintained in a wilted state. Such leaves produced about as much exudate as turgid leaves of unstressed plants. The following observations suggest a phloem origin for most of the exudate. Exudation was markedly stimulted by light and by CO_2 enrichment. The release of NO_3^- declined after cutting, and did not parallel exudation of $^{14}CO_2$ assimilates, sugar, and amino acids. The relative quantities and specific radioactivities of sugars and amino acids in the exudate differed from those of sugars and amino acids extracted from sheath tissue. Major amino acids in exudate from unstressed seedling and flag leaves were glutamine, glutamate, serine, alanine, and aspartate; proline was virtually absent. Exudate from water-stressed leaves contained relatively more serine, and also some proline and γ-aminobutyric acid.

18054 Amino acids translocated from turgid and water-stressed barley leaves. II. Studies with ^{13}N and ^{14}C. Hanson, A.D.; Tully, R.E. (Michigan State Univ., East Lansing). Contract EY-76-C-02-1338. *Plant Physiol.;* **64**: No. 3, 467-471(Sep 1979).

Movement of labeled amino acids from leaf blades to sheaths was followed after supplying $^{13}NH_3$ gas, $^{14}CO_2$, or ^{14}C-amino-acids to attached blades of barley plants. Blades of turgid and wilted plants fed $^{13}NH_3$ (at about 120 to 700 microliters per liter) had incorporated ^{13}N mainly into free glutamine and glutamate after 30 minutes, and turgid blades had exported 1 to 3% of the assimilated ^{13}N to the sheaths, mostly as glutamine and glutamate. Wilted blades exported less of the assimilated ^{13}N than turgid blades even though they exported $^{14}CO_2$ assimilates as actively as turgid blades. When substrate amounts (about 0.28 micromole) of ^{14}C-labeled-glutamate and ^{14}C labeled-proline were applied to turgid and wilted blades, these amino acids entered the phloem and were translocated at velocities similar to those for $^{14}CO_2$ assimilates (about 0.2 centimeter per minute). Wilted blades metabolized tracer amounts of ^{14}C labeled-glutamate to glutamine and proline, and exported ^{14}C in the form of these three amino acids. Approximate calculations of mass transfer rates of glutamate, glutamine, and proline made for wilted blades indicated that glutamine and glutamate together carried 76 micrograms of N per day, whereas proline carried only about 9 micrograms of N per day.

18055 Chlorophyll turnover in Skeletonema costatum, a marine plankton diatom. Riper, D.M.; Owens, T.G.; Falkowski, P.G. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Plant Physiol.;* **64**: No. 1, 49-54(Jul 1979).

(^3H)- and δ-(^{14}C)aminolevulinic acids were incorporated into the chlorophylls of Skeletonema costatum, a marine plankton diatom. In the stationary phase of growth, the tetrapyrrole-based pigments reached steady-state labeling after 10 hours. Under conditions of exponential cell division and chlorophyll accumulation, ^3H was rapidly lost from the labeled chlorophylls and was replaced with ^{14}C derived from δ-(4-^{14}C)aminolevulinic acid. The kinetics of isotope dilution suggests recycling of tetrapyrrole precursors and/or two pigment pools, containing both chlorophyll a and chlorophyllide c, one which turns over rapidly (10 hours) and another which turns over more slowly (100 hours). Calculation of turnover times varied from 3 to 10 hours for chlorophyll a and from 7 to 26 hours for chlorophyllide c. The data suggest the dynamics of chlorophyll metabolism in S. costatum and explain the diatom's ability to undergo light-shade adaptation within a generation time.

18056 Cerebral blood flow and oxygen consumption in the newborn dog. Hernandez, M.J.; Brennan, R.W.; Vannucci, R.C.; Bowman, G.S. (Pennsylvania State Univ., Hershey). *Am. J. Physiol.;* **234**: No. 5, R209-R-215(May 1978).

Cerebral blood flow (CBF), CBF responses to changes in arterial CO_2 tension, and cerebral metabolic rate for oxygen ($CMRO_2$) were measured in newborn dogs, by means of a modification of the Kety and Schmidt technique employing ^{133}Xe. Mongrel dogs of 1 to 7 days of age were paralyzed and passively ventilated with 70% N_2O and 30% O_2. CBF was derived by analysis of paired serial 20-microliter samples of arterial and of cerebral venous blood from the superior sagittal sinus. At an arterial PCO_2 of 36.9 +- 3.7 Torr and a mean arterial blood pressure of 62 +- 10 Torr, CBF was 23 +- 8 ml/min per 100 g. The arteriovenous oxygen content difference averaged 5.6 vol %, and $CMRO_2$ was 1.13 +- 0.30 ml O_2/min per 100 g. CBF increased or decreased by 0.58 ml/min/100 g per Torr change in PCO_2. Our results suggest that in the newborn, basal CBF and CBF responses to CO_2 are considerably lower than in the adult and parallel the lower metabolic needs of the newborn brain.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 17807, 18079

18057 Wood for energy: skidding firewood with small tractors. A report on two field trials. Stevens, D.C.; Smith, N.R. Morrisville, VT; Vermont Department of Forests, Parks and Recreation (1978). 17p. (NP—24318).

In Vermont as the demand for fuelwood continues to rise, the more accessible land is being harvested. In the near future it will be necessary to harvest steeper, wetter, and other less accessible tracts if the entire resource base is to be utilized. The Vermont Department of Forests, Parks and Recreation is directly concerned with the wise and efficient use of our forest resource. Of equal concern is the application of proper forest management to the resource. As an assistance to the landowners, loggers, and fuelwood consumers of Vermont, the Department of Forests, Parks and Recreation conducted two field trials to demonstrate the application of small tractors to skidding firewood.

18058 Potential argicultural uses of fluidized bed combustion waste. Bennett, O.L.; Stout, W.L.; Hern, J.L.; Sidle, R.C. (West Virginia Univ., Morgantown). pp 84-89 of Energy and the environment. Proceedings of the fifth national conference. Nichols, D.G.; Rolinski, E.J.; Servais, R.A.; Theodore, L.; Buonicore, A.J. (eds.). Dayton, OH; American Institute of Chemical Engineers (1978).

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

A comprehensive research program is in progress to evaluate the potential of FBC waste material for agricultural use throughout the eastern US. Limited preliminary information indicates that FBC waste may be used as a limiting agent or sulfur source. It is important that this material be fully evaluated over time to define any potential problems arising from the heavy metals contained in the waste. We cannot afford to jeopardize the future use and production from our agricultural soils through hasty use of this material.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON CELLS

REFER ALSO TO CITATION(S) 18071

EXTERNAL SOURCE

18059 X-ray response of Chinese hamster ovary cells during the latter part of G_2. Griffiths, T.D. (Univ. of Rochester, NY). *Biophys. J.;* **28**: No. 3, 497-501(Dec 1979).

The ability of Chinese hamster ovary (CHO) cells to repair x-radiation damage during the transit from the late G_2 to early M cell cycle stages was investigated by conventional dose-fractionation techniques. Despite their relatively high radiation sensitivity, CHO cells positioned in late G_2 exhibit increased survival when a given dose of ionizing radiation is administered as two fractions (separated by 40 to 50 min) instead of as a single fraction. This increased survival apparently represents repair since neither cell cycle progression nor changes in the number of effective targets can account for the observed dose-sparing effect.

18060 Drastic G_2 arrest in mammalian cells after irradiation with heavy-ion beams. Luecke-Huhle, C.; Blakely, E.A.; Chang, P.Y.; Tobias, C.A. (Univ. of California, Berkeley). *Radiat. Res.;* **19**: No. 1, 97-112(Jul 1979).

Unsynchronized exponentially growing V79 monolayer cultures were exposed to high-energy accelerated heavy-ion beams (^{12}C, ^{20}Ne, ^{40}Ar) at various positions in their unmodified Bragg ionization curves. High-LET particle beams proved to be much more effective in causing a G_2 + M block, measured by the method of flow microfluorometry, than low-LET radiation. The number of cells arrested in G_2 + M increased linearly with dose up to at least 75% of the maximum effect. In this domain, the RBE values were LET-dependent with a maximum (RBE_{30} = 8.3) at about 100 keV/μm. In contrast to γ and x rays, heavy ions with high LET did not affect cell traverse through the G_1 and S phase. Though the RBE values for G_2 + M block are much higher than the RBEs for survival, there was a linear relationship between accumulation of cells in G_2 + M and cell killing.

18061 Premature chromosome condensation following x irradiation of mammalian cells: expression time and dose-response. Griffiths, T.D.; Carpenter, J.G. (Univ. of Rochester, NY). *Radiat. Res.;* **19**: No. 1, 187-202(Jul 1979).

Premature chromosome condensation (PCC) in Chinese hamster ovary (CHO) cells following exposure to 300-kVp x rays was first detected in the mitosis that followed the second postirradiation S phase. Thus, cells irradiated in G1 first expressed PCC at the second postirradiation mitosis while cells irradiated in G2 did not express PCC until the third postirradiation mitosis. Cells irradiated in the S phase expressed PCC at the second postirradiation mitosis with a frequency that was related to the position of the cells in the S phase at the time of exposure, cells in the first half of the S phase (at the time of exposure) showing a higher frequency than cells positioned in the second half. Thus, DNA replication during the first postirradiation S phase may be involved in the processing of lesions that eventually give rise to PCC. For cells in G1 at the time of exposure, the D/sub o/ for PCC expression at the second postirradiation mitosis was around 825 rad, indicating that PCC may play only a minor role in x-ray-induced cell killing. Autoradiographic analysis indicated approximately 50% of the PCC patches scored were replicating DNA at the time condensation was attempted. Daughter cells derived from such cells would suffer loss of genetic material.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 17455, 17456

18062 (COO—3017-40) **Risk of cancer subsequent to low-dose radiation.** Warren, S. (New England Deaconess Hospital, Boston, MA (USA). Cancer Research Inst.). 1980. Contract AC02-76EV0317. 11p. (CONF-800228—1). Dep. NTIS, PC A02/MF A01.

From 32. annual meeting of the American Academy of Forensic Sciences; New Orleans, LA, USA (20 Feb 1980).

The author puts low dose irradiation risks in perspective using average background radiation doses for standards. He assailed irresponsible media coverage during the height of public interest in the Three-Mile Island Reactor incident. (PCS)

18063 Cancer mortality in Hanford workers. Marks, S.; Gilbert, E.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)); Breitenstein, B.D. (Hanford Environmental Health Foundation, Richland, WA (USA)). pp 369-386 of Late biological effects of ionizing radiation. Vol. 1. Proceedings of the symposium held by the IAEA in Vienna, 13-17 March 1978. Vienna, Austria; International Atomic Energy Authority (1978).

Personnel and radiation exposure data for past and present employees of the Hanford plant have been collected and analysed for a possible relationship of exposure to mortality. The occurrence of death in workers was established by the Social Security Administration and the cause of death obtained from death certificates. Mortality from all causes, all cancer cases and specific cancer types was related to the population at risk. Standardized mortality ratios were calculated for white males, using age- and calendar year-specific mortality rates for the U.S. population in the calculation of expected deaths. This analysis showed a substantial 'healthy worker effect' and no significantly high standardized mortality ratios for specific disease categories. A test for association of mortality with levels of radiation exposure revealed no correlation for all causes and all cancer. In carrying out this test, adjustment was made for age and calendar year of death, length of employment and occupational category. A statistically significant test for trend was obtained for multiple myeloma and carcinoma of the pancreas. However, in view of the absence of such a correlation for diseases more commonly associated with radiation exposure such as myeloid leukaemia, as well as the small number of deaths in higher exposure groups, the results cannot be considered definitive. Any conclusions based on these associations should be viewed in relation to the results of other studies. These results are compared with those of other investigators who have analysed the Hanford data.

18064 (LBL—10494) **BEIR-III report and its implications for radiation protection and public health policy.** Fabrikant, J.I. (California Univ., Berkeley (USA). Donner Lab.). Mar 1980. Contract W-7405-ENG-48. 21p. (CONF-800304—10). Dep. NTIS, PC A02/MF A01.

From 5. international congress of the International Radiation Protection Association; Jerusalem, Israel (8 Mar 1980).

A general background is given of the implications the BEIR-III Report may have on societal decision-making in the regulation of activities concerned with the health effects of low-level radiation. The scientific basis for establishing appropriate radiation protection guides are discussed. (ACR)

18065 Estimate of the risk in radiation therapy due to unwanted neutrons. Swanson, W.P. (Stanford Linear Accelerator Center, Stanford University, Stanford, CA 94305). DE-AC03-765SF00515. *Med. Phys.;* **7**: No. 2, 141-144(Mar 1980).

The integral dose of accelerator-produced leakage neutrons to patients undergoing high-energy photon therapy is estimated and compared to other sources of integral dose. The leakage neutron component contributes about 5 g rad (1 rad = 10^{-2} Gy) for a typical treatment course of 5000 rad. When averaged over a 70-kg tissue volume, the corresponding dose amounts to only 0.36 rad. From this, the risk of inducing fatal malignancies by leakage neutrons is estimated to be about 50 x 10^{-6} per year following treatment. This is compared to other risks to which the patient is unavoidably exposed, and it is argued that the unwanted neutrons pose such small additional risk that regulatory intervention is not warranted. This assessment is performed without reference to neutron RBE or quality factor.

18066 Mortality among women first employed before 1930 in the US radium dial-painting industry. A group ascertained from employment lists. Polednak, A.P.; Stehney, A.F.; Rowland, R.E. (Argonne National Lab., IL). *Am. J. Epidemiol.;* **107**: No. 3, 179-195(Mar 1978).

Mortality is described among a cohort of 634 women who worked in the US radium dial-painting industry between 1915 and 1929, and whose names were obtained from employment lists or similar documents. Based on death rates for US white females, greater than expected numbers of deaths (from death certificates) were observed for all causes (240 observed vs 188.5 expected), bone cancer (22 vs 0.3), cancer of other and unspecified sites (18 vs 2.6), cancer of the colon (10 vs 5.0), diseases of blood and blood-forming organs (4 vs 1.0), and external causes (31 vs 10.1). Six of 22 certificates coded to radiation accident (underlying cause) also mentioned bone cancer. Compared with women first employed in 1915-1924, those first employed in 1925-1929 had low cause-specific mortality ratios, and an overall mortality ratio of 0.83. The number of deaths from leukemia and diseases of blood was significantly greater than expected in the time period before 1945. Among 521 women alive in 1954, 360 had a radium body-burden measurement while living (in 1954 or later). Mortality ratios (all causes) of greater than 1.00 were observed only in the higher intake dose groups (i.e., $\geqq$ 50 μCi). Cause-specific mortality was analyzed in two dose groups ($<$ 50 and $\geqq$ 50 μCi). In the lower dose group, the only cause category with a significantly greater number of observed than expected deaths was cancer of the colon (5 vs 1.72, $p < 0.05$); the mortality ratio for all causes was 0.86. In the higher dose group, the mortality ratio for all causes was 1.91.

18067 Re-analysis of data relating to the Hanford study of the cancer risks of radiation workers. Kneale, G.W.; Stewart, A.M.; Mancuso, T.F. (Pittsburgh Univ., PA (USA). Dept. of Industrial Environmental Health Sciences). pp 387-410 of Late biological effects of ionizing radiation. Vol. 1. Proceedings of the symposium held by the IAEA in Vienna, 13-17 March 1978. Vienna, Austria; International Atomic Energy Authority (1978).

A study of workers in the nuclear industry who had linked records of external radiation doses and certified causes of death (1944-72 deaths of Hanford workers) was followed by a similar analysis of a larger sample of Hanford data (1944-77 deaths). The second study included one test which showed that, in surveys of the delayed effects of low-level radiation, comparisons between observed and expected doses of cancer cases (CMD method) are more informative than comparisons between observed and expected cancer deaths of exposed workers (SMR method). A second test (which took the form of a Mantel-Haenszel analysis and included exposure period and interval radiation among the controlling factors) showed that there were genuine differences between the radiation dose of two groups of certified deaths (cancers and non-cancers). Both studies produced evidence of a cancer hazard from low doses of external radiation even when delivered at low dose rates. According to the second study, approximately 5% of the cancer deaths of Hanford workers were radiation-induced, and these extra deaths were probably concentrated among cancers of tissues which rate high in the ICRP 14 classification of radiosensitivity (e.g. bone marrow, pharynx and lung, pancreas and small intestine).

18068 Survival times of women radium dial workers first exposed before 1930. Stehney, A.F.; Lucas, H.F. Jr.; Rowland, R.E. (Argonne National Lab., IL (USA)). pp 333-350 of Late biological effects of ionizing radiation. Vol. 1. Proceedings of the symposium held by the IAEA in Vienna, 13-17 March 1978. Vienna, Austria; International Atomic Energy Authority (1978).

Life table methods were applied to survival data on U.S. women radium dial workers in order to compare observed and expected deaths as a function of time after exposure to radium. The study population consisted of 1235 workers employed in the industry before 1930 for whom age and year of death, withdrawal or loss from the study were known. Expected deaths were estimated from age- and time-specific death rates for U.S. white females. The closing year for analysis was 1976, so observation times of 45 to 60 years were possible. For all causes, 529 deaths before age 85 were ob-

served versus 461 expected, and the cumulative survival of the population was significantly less than expected at 10 and more years after first employment. Estimates were made of the net survival probabilities after elimination of risk due to the well-known radium-related malignancies, i.e. bone sarcomas and carcinomas of the paranasal sinuses and the mastoid air cells. There were 455 observed deaths from other causes versus 460 expected, and there was no significant difference between observed and expected cumulative net survival at one-year intervals from zero to 59 years after first employment. These findings indicate that only the known radium-related malignancies contributed significantly to life shortening of the exposed population as a whole, but the presence of other radium-related causes of death may yet be detectable by examination of specific risks as a function of dose.

18069 Studies on persons exposed to plutonium. Voelz, G.L.; Stebbings, J.H.; Hempelmann, L.H.; Haxton, L.K.; York, D.A. (Los Alamos Scientific Lab., NM (USA)). pp 353-366 of Late biological effects of ionizing radiation. Vol. 1. Proceedings of the symposium held by the IAEA in Vienna, 13-17 March 1978. Vienna, Austria; International Atomic Energy Authority (1978).

The results of four studies of persons exposed, or potentially exposed, to plutonium are summarized. The studies are: (1) a five-year update on clinical examinations and health experience of 26 Manhattan District workers heavily exposed at Los Alamos in 1944-45; (2) a 30-year mortality follow-up of 224 white male workers with plutonium body burdens of 10 nCi or more; (3) a review of cancer mortality rates between 1950 and 1969 among Los Alamos County, New Mexico, male residents, all of whom have worked in or have lived within a few kilometres of a major plutonium plant and other nuclear facilities; and (4) a review of cancer incidence rates between 1969 and 1974 in male residents of Los Alamos County. No excess of mortality due to any cause was observed in the 224 male subjects with the highest plutonium exposures at Los Alamos. The total cancer and cardiovascular mortality rates were lower than expected based on age and year-specific rates for United States white males. Lung cancer mortality was lower than expected and no bone or liver cancer was experienced. Clinical examinations of the Manhattan District workers, whose average age in 1976 was 56 years, show them to be active persons with diseases that are not unusual for their ages. The two deaths in this group over the past 30 years have not been due to cancer. The mortality study of Los Alamos male residents showed a possible excess of cancers of the combined lymphatic and haematopoietic tissues, but the incidence data suggest this excess, if real, is no longer occurring. Higher than expected incidence of cancers of the digestive tract in Los Alamos males and females is more likely to be due to socio-economic and cultural factors than to occupational exposures. Mortality and incidence data indicate no excess of lung cancer in Los Alamos males.

VERTEBRATES

18070 Haemopathological consequences of protracted gamma irradiation in the beagle. Pre-clinical phases of leukaemia induction. Seed, T.M.; Tolle, D.V.; Fritz, T.E.; Cullen, S.M.; Kaspar, L.V.; Poole, C.M. (Argonne National Lab., IL (USA)). pp 531-543 of Late biological effects of ionizing radiation. Vol. 1. Vienna; IAEA (1978).

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

Myelogenous leukaemia is the most important late effect in beagles given continuous ^{60}Co-gamma irradiation beginning at one year of age. We recognize four distinct pre-clinical phases in leukaemia development: (I) progressive development of severe leukopenia and thrombocytopenia; (II) partial haemopoietic recovery after 2000 R of accumulated exposure; (III) an equilibration of subnormal haemopoietic function; and (IV) a classical preleukaemic phase. Overt leukaemia is the fifth and last phase of the sequences that ends in a terminal anaemia. We are characterizing these phases haematologically and ultrastructurally through serial blood and bone marrow sampling, and also by endotoxin-stress assays and in vitro stem cell cloning experiments. Entry into phase II, partial haemopoietic recovery, appears to be a deciding factor for leukaemic induction. Dogs failing to enter this phase (approximately 50%) are recognized early by (a) development of a progressive pancytopenia, and (b) morphological and functional changes in supportive structures and cellular reserves of the bone marrow; they later die of aplastic anaemia. Dogs eventually developing leukaemia, however, partially recover the haemopoietic functions lost in phase I. Restoration becomes evident after 200-300 days of irradiation as an increase in peripheral blood platelets and leukocytes. This is later accompanied by renewed marrow function, specifically observed as a progressive increase in marrow cellularity, with partial restoration of the granulocyte reserves and progenitor-cell compartments. Serum collected in phase I appears to have an enhanced stimulatory effect on normal granulopoiesis, in vitro, but this subsequently declines as marrow cellularity increases late in phase III. The preleukaemic phase (phase IV) is most notably characterized by a greatly exaggerated oscillation in blood platelet values, and by circulating immature granulocytes and erythrocytes with various morphologic abnormalities.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

18071 (BNL—27148) **Summary and recommendations for research on tritium toxicity.** (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 37p. (CONF-7908106—(Summ.)). Dep. NTIS, PC A04/MF A01.

From Conference on 3H toxicity; Upton, NY, USA (3 Aug 1979).

Portions of document are illegible.

Lengthy presentations on many aspects of ^{3}H and its toxicity were given: ^{3}H Decay - Anticipated Q, J. Booz; Influence of Dose and Dose Rate on RBE, L. Feinendegen; ^{3}H Effects on Stem Cells and Dominant Lethals, A. Carsten; ^{3}H Incorporation into Murine Molecular Species, S. Commerford; ^{3}H and Hemopoietic Effects, T. Fliedner; Evidence for Site-Specific Genetic Transmutation Effects, M. Bender; ^{3}H and Effect on Testes, A. Lambert; ^{3}H and Oocytes, L. Dobson; and ^{2}H Incorporation into Oocytes as a Stable Isotope Tracer for ^{3}H, D. Slatkin.

ANIMALS

18072 Pulmonary retention of neutron-activated coal dust. Morrow, P.E.; Gibb, F.R.; Beiter, H.; Kilpper, R.W. (Univ. of Rochester, NY). *Arch. Environ. Health;* **34**: No. 3, 178-183(May 1979).

Coal dust aerosols with cesium-134 and scandium-46 labels were studied in dogs and rats following brief inhalation exposures by external measurement of gamma photons in the 0.6 to 0.8 and 0.9 to 1.1 MeV regions, respectively. Ancillary in vitro studies of the leaching characteristics of the two radionuclides from coal were made and control studies utilizing the free radionuclides were undertaken for each of the investigations with radioactive coal dust. The biological data strongly infer that coal dust retention in canine lungs is extremely protracted with a biological half-life no shorter than approximately 4.3 yr and probably much longer. The biological model which was formulated and analyzed to obtain this finding is disucssed along with its limitations.

THERMAL EFFECTS

MICROORGANISMS

REFER ALSO TO CITATION(S) 18073

INVERTEBRATES

18073 (ORNL/EIS—157) **Thermal effects on aquatic organisms: an annotated bibliography of the 1978 literature.** Talmage, S.S. (comp.). (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 160p. Dep. NTIS, PC A08/MF A01.

This bibliography, containing 457 references from the 1978 literature, is the eighth in a series of annotated bibliographies on the effects of heat on aquatic organisms. The effects of thermal discharges at power plant sites are emphasized. Laboratory and field studies on temperature tolerance and the effects of temperature changes on reproduction, development, growth, distribution, physiology, and sensitivity to other stresses are included. References in the bibliography are divided into three subject categories: marine sytems, freshwater systems, and estuaries. The references are arranged alphabetically by first author. Indexes are provided for author, keywords, subject category, geographic location of the study, taxon, and title (alphabetical listing of keywords-in-context of nontrivial words in the title).

VERTEBRATES

REFER ALSO TO CITATION(S) 18073

18074 Thermal shock resistance of spot (Leiostomus xanthurus) after acclimation to constant or cycling temperature. Hartwell, S.I. (North Carolina State Univ., Raleigh); Hoss, D.E. *Trans. Am. Fish. Soc.;* **108**: No. 4, 397-400(Jul 1979).

Postlarval and juvenile spots were acclimated to selected constant temperatures and to diel temperature cycles. Following acclimation they were exposed to temperature shocks from 0 C (control) to 20 C above acclimation temperatures. Twenty-four-hour median lethal shock temperatures (LS50 values) were calculated by probit analysis. The temperature cycles used has no apparent effect on the thermal shock resistance of either postlarval or juvenile spots relative to constant-temperature acclimation. When acclimated at the

same temperatures, postlarvae had lower thermal shock resistances than juveniles. Most mortality occurred within 10 minutes of shock onset.

18075 Amounts of asymmetry in centrarchid fish inhabiting heated and nonheated reservoirs. Ames, L.J.; Felley, J.D.; Smith, M.H. (Savannah River Ecology Lab., Aiken, SC). *Trans. Am. Fish. Soc.;* **108**: No. 5, 489-495(Sep 1979).

The effects of heated effluents on morphology of fishes in natural populations were investigated. Largemouth bass (Micropterus salmoides), bluegills (Lepomis macrochirus), and redbreast sunfish (Lepomis auritus) were sampled in bodies of water that had never experienced thermal effluents, in those that were currently receiving heated effluents, and in those that had received heated effluents in the past, but received them no longer. Differences in means between heated and ambient temperature locations were seen only in two meristic characters in the redbreast sunfish. Differences in amounts of bilateral asymmetry (hypothesized to be a measure of developmental homeostasis) were not demonstrated between populations in heated and ambient-temperature locations. However, fish from a pond heavily contaminated with mercury had higher levels of asymmetry than fish from the other populations sampled.

18076 Growth rates and size distributions of first-year smallmouth bass populations: some conclusions from experiments and a model. DeAngelis, D.L.; Coutant, C.C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Trans. Am. Fish. Soc.;* **108**: No. 2, 137-141(Mar 1979).

Growth rates of populations of first-year smallmouth bass (Micropterus dolomieui Lacepede) were studied during the first few weeks of life at temperatures ranging from 15.2 to 32.5 C. In all cases, the average length of fish in each group increased linearly with time, t, in a range from 10 to 30 mm. The variances about these mean lengths increased approximately as t^2. A partial differential equation model can be useful in expressing the dynamics of populations in which size distributions are taken into consideration. Applied to our experiment, this type of model shows that both of the observed length-versus-time phenomena are expected if the rates of increase of length of fish are independent of length and that these rates for individual fish are normally distributed about some mean rate of growth. The variance of individual growth rates needed to produce the observed length-versus-time data can be calculated from the model.

18077 Techniques for measuring the effects of nuclear power plants on local fish. Acker, W.C. (Univ. of Washington, Seattle). pp 23C.1-23C.2 of Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

The Applied Physics Laboratory and Fisheries Research Institute at the University of Washington have developed acoustic equipment and techniques that are now being used to help access the effects of coastal power plants on fish. The technique consists of acoustic assessment of fish abundance with a portable, towed assessment system and simultaneous measurement of the temperature at several depths in and around the thermal plume. When the acoustic-temperature measurements are used in conjunction with an acoustically directed sample fishing program, data on species composition can also be obtained.

CHEMICALS METABOLISM AND TOXICITY

18078 Reactions of ozone with fatty acid monolayers: a model system for disruption of lipid molecular assemblies by ozone. Srisankar, E.V.; Patterson, L.K. (Univ. of Notre Dame, IN). *Arch. Environ. Health;* **34**: No. 5, 346-349(Sep 1979).

Ozone concentrations of 0.03 ppM are shown to initiate physical disruption of both oleic and linoleic acid spread monolayers in a few seconds. Approximately equal yields of water soluble products in nitrogen- and oxygen-containing environments as well as in the two acid systems suggest that the dominant reaction pathway involves direct attack on fatty acid double bonds and not oxidative chain reactions. A possible explanation for the observed loss of monolayer material is provided by the Criegee mechanism for ozonide rearrangement following ozone attachment to double bonds. In this scheme polar intermediates are generated which could pass into the aqueous subphase before recombination can occur. α-Tocopherol exhibits a protective effect only when present at a high fraction in the fatty acid monolayer (6 mole%). These systems provide an efficient elementary model for studying the physical effects of ozone on lipid membrane structure.

MICROORGANISMS

18079 (SNV-PM—1208) Effects of pesticides on soil organisms. 2. Microorganisms. Torstensson, L. (Statens Naturvaardsverk, Solna (Sweden)). Jul 1979. 154p. (In Swedish). Dep. NTIS (US Sales Only), PC A08/MF A01.

The scientific literature concerning effects of pesticides on the microorganims of the soil was surveyed and the results given in tabulated form for each pesticide. For the sake of clarity, the microorganism flora has been subdivided into five different levels of function: (I) single microorganism species; (II) populations of microorganisms: (III) changes within the total microorganism flora; (IV) groups of microorganisms with a special function; and (V) enzyme activity of the soil. Suggestions for optimization of tests for effects of pesticides on soil microorganisms are given. There are three major areas for improvements: (a) increased knowledge of the function of soil ecosystems; (b) standardization of test methods and test conditions; and (c) evaluation of test results.

18080 Effects of arsenic speciation and phosphate concentration on arsenic inhibition of Skeletonema costatum (bacillariophyceae). Sanders, J.G. (Skidaway Inst. of Oceanography, Savannah, GA). *J. Phycol.;* **15**: No. 4, 424-428(Dec 1979).

Arsenate is taken up readily by Skeletonema costatum (Greville) Cleve due to its chemical similarity to phosphate, and it inhibits primary productivity at concentrations as low as 67 nM when the phosphate concentration is low. A phosphate enrichment of greater than 0.3 μM alleviates this inhibition; however, the arsenate stress causes an increase in the cell's requirement for phosphorus. Arsenite is also toxic to Skeletonema at similar concentrations. Methylated species, such as dimethylarsinic acid, did not affect cell productivity at the levels examined. Thus, the reduction and methylation of arsenate to dimithylarsinic acid by the cell produces a stable, non-toxic compound.

PLANTS

REFER ALSO TO CITATION(S) 18053, 18054

18081 (ISM—260) Trace element levels and their enrichment processes in terrestrial vegetation. O'Toole, J.J.; Wessels, T.E.; Malaby, K.L. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 14p. (CONF-791145—1). Dep. NTIS, PC A02/MF A01.

From International symposium on trace elements stress in plants; Los Angeles, CA, USA (6 Nov 1979).

Sampling sites were installed in the native plant communities northwest and southeast of Colstrip, Montana. Spring and fall foliage was sampled from three perennial grasses and two deciduous shrubs. Analysis for over thirty elements is reported and their relationships to site, species, and season is statistically evaluated. Elemental enrichments of vegetation due to physiological processes, soil, and power plant plume aerosols are assessed. These processes and the sensitivity for detecting certain contaminating elements are discussed in the light of the data reported and its statistical treatment.

VERTEBRATES

REFER ALSO TO CITATION(S) 18072, 18075

18082 (CONF-800125—1) Overview of the current and planned research program of the respiratory unit, Oak Ridge National Laboratory, Part I. Marchok, A.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Environmental Protection Agency oxidants research planning workshop; Raleigh, NC, USA (27 Jan 1980).

In order to study the morphogenesis of lung cancer, inhalation experiments on animals pretreated with carcinogens were performed. Tracheal washing to precondition the respiratory tract epithelium before exposure to aerosols was described. Rat tracheal transplant experiments are discussed. Polycyclic hydrocarbons released from beeswax pellets were used as the carcinogen. Cholesterol and various polymers were used to control the release of carcinogen and examine the co-carcinogenic effect of such agents on the respiratory epithelium. (DC)

18083 (CONF-800125—2) Overview of the current and planned research program of the respiratory unit, Oak Ridge National Laboratory, Part II. Dalbey, W.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. Dep. NTIS, PC A02/MF A01.

From Environmental Protection Agency oxidants research planning workshop; Raleigh, NC, USA (27 Jan 1980).

This presentation will be concerned with an overview of current work at the inhalation facility at Oak Ridge National Laboratory which deals with oxidant gases. Three main areas will be discussed. These are: (1) irritant gases as cofactors in nitrosamine-induced tumorigenesis, (2) modulation of tumor incidence using the tracheal washing model for tumor induction, and (3) the role of frequency and duration of oxidant gas exposure on pulmonary toxicity. Since man is rarely exposed to doses of chemical carcinogens large enough to result in tumors by themselves, investigations of factors which could influence tumor incidence from carcinogen exposure are of great practical importance.

18084 (UCID—18288) **Biogeochemical studies of wintering waterfowl in the Imperial and Sacramento Valleys.** Koranda, J.J.; Stuart, M.; Thompson, S.; Conrado, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 120p. Dep. NTIS, PC A06/MF A01.

Trace and major elemental composition were determined in the organs of wintering waterfowl in the Imperial and Sacramento Valleys of California, and in soils, sediments, and agricultural fertilizer that constitute the various sources of elements in the waterfowl. These data provide a biogeochemical baseline for waterfowl populations wintering in an area being developed for geothermal power. This baseline in the Imperial Valley is affected by soil and sediment composition, agricultural effluents in irrigation and stream water, and spent shot deposited by hunters in waterfowl habitats. The waterfowl acquire a set of trace elements from these sources and concentrations increase in their organs over the wintering period. Nickel, arsenic, selenium, bromine, and lead are the primary elements acquired from soil sources, agricultural effluents, and spent shot in the Imperial Valley. The assessment of effects from geothermal effluents on waterfowl populations in complex because there are large influxes of materials into the Imperial Valley ecosystem that contain trace elements, i.e., irrigation water, phosphatic fertilizers, pesticides, and lead shot. Multiple sources exist for many elements prominent in the expected geothermal effluents. The relationships between the two California valleys, the Imperial and Sacramento, are apparent in the trace element concentrations in the organs of waterfowl obtained in those two valleys. Arsenic is absent in the waterfowl organs obtained in the Sacramento Valley and relatively common in the Imperial Valley waterfowl. The effect of any release of geothermal effluent in the Imperial Valley waterfowl habitats will be difficult to describe because of the complexity of the biogeochemical baseline and the multiple sources of trace and major elements in the ecosystem.

18085 **Effect of enzyme-induced pulmonary emphysema in Syrian hamsters on the deposition and long-term retention of inhaled particles.** Hahn, F.F.; Hobbs, C.H. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Arch. Environ. Health;* **34**: No. 4, 203-211(Jul 1979).

Experimental emphysema was induced in Syrian hamsters by: (a) intratracheal instillation of elastase; or (b) inhalation of papain aerosols. After 3 wk, treated and control groups were simultaneously exposed to an aerosol of relatively insoluble ^{137}Cs-labeled, heat-treated aluminosilicate particles with an aerodynamic diameter of 1.4 or 1.6 μm. The lung deposition of particles measured 3 hr after inhalation exposure was significantly lower in hamsters exposed to elastase or papain. The mean whole-body retention data for each group were fitted with three-component exponential equations. The first component, which represented early clearance and constituted 78% to 83% of the initial body burden in all groups, occurred rapidly with a half-time of 0.6 to 0.8 days, and probably represented particles deposited in the nasopharynx and ciliated airways. The second component represented an intermediate clearance phase and was much faster in animals with emphysema than in controls. The enzyme treatments resulted in a prolonged half-time in the long-term clearance component. The effect of both enzyme treatments on the retention of particles was similar although the patterns of emphysema produced differed. Elastase instilled intratracheally caused diffuse destruction and enlargement of alveoli with a loss of pulmonary elastic recoil. Papain aerosols caused focal destruction and enlargement of alveoli around terminal bronchioles with no loss of elastic recoil. A common feature was an increased number of alveolar macrophages, which may account for the increased, early clearance of particles. The prolonged retention of a small fraction of particles may be due to focal accumulations of particle-laden macrophages which were prominent in distal alveoli of the papain-exposed hamsters and, to a lesser degree, in the elastase-treated hamsters.

18086 **Program to introduce site-specific chlorination regimes at Ontario Hydro Generating Stations.** Grieve, J.A.; Johnston, L.E.; Dunstall, T.G.; Minor, J. (Ontario Hydro, Toronto). pp 77-94 of Water chlorination: environmental impact and health effects. Volume 2. Jolley, R.L.; Gorchev, H.; Hamilton, D.H. Jr. (eds.). Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978).

From Conference on water chlorination: environmental impact and health effects; Gatlinburg, TN, USA (31 Oct 1977).

A site-specific chlorination regime was developed to optimize station efficiency compatible with its operating mode and at the same time ensure environmental stability. The plan considered size and decay of the chlorine plume; effects of chlorine discharge on white bass; and methods of low-concentration chlorine analysis. (PCS)

MAN

18087 **Cigarette smoke inhalation decreases α_1-antitrypsin activity in rat lung.** Janoff, A. (State Univ. of New York, Stony Brook); Carp, H.; Lee, D.K.; Drew, R.T. Contract EY-76-C-02-0016. *Science;* **206**: 1313-1314(14 Dec 1979).

Brief inhalation exposure of rats to three or six puffs of cigarette smoke significantly decreases elastase inhibitory capacity per milligram of α_1-antitrypsin in lung lavage fluid. This effect is not observed in ozone-tolerant rats and can be reversed by treating the lung lavage fluid from smoke-exposed rats with reducing agents. Samples of human serum obtained immediately after smoking also show decreased elastase inhibitory capacity per milligram of α_1-antitrypsin. Again, elastase inhibitory capacity can be restored by treatment with a reducing agent. Cigarette smoking may cause emphysema by inactivating α_1-antitrypsin through oxidation.

18088 **Long-term mortality study of workers occupationally exposed to metallic nickel at the Oak Ridge Gaseous Diffusion Plant.** Godbold, J.H. Jr.; Tompkins, E.A. (Oak Ridge Associated Univ., Oak Ridge, TN). *J. Occup. Med.;* **21**: No. 12, 799-806(Dec 1979).

This study was undertaken to determine whether mortality from respiratory cancer among workers occupationally exposed to metallic nickel at the Oak Ridge Gaseous Diffusion Plant (ORGDP) differed from that of workers at the same plant with no record of occupational exposure to metallic nickel or any nickel compound. A cohort of 814 nickel-exposed workers and one of 1600 controls were identified. The members of both cohorts had a minimum follow-up period of 19 years. Mortality from respiratory cancer and from other causes was examined in both groups. The data showed no evidence of an increased risk of mortality due to respiratory cancer among the nickel-exposed workers. The exposed cohort experienced lower mortality than the controls, both in deaths due to respiratory cancer and in deaths due to all causes, although neither of these differences was statistically significant.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

18089 (FDA—80-8103) **Analysis of some laser light show effects for classification purposes.** Royston, D.D. (Bureau of Radiological Health, Rockville, MD (USA)). Nov 1979. 23p. NTIS.

Some laser effects in laser lght shows irradiate audiences directly with laser radiation. This laser radiation must be below Class I accessible emission limits. If actual radiometric measurements cannot be performed, a numerical analysis of the laser effect can be made to determine if the accessible laser radiation is below acceptable limits. An analysis is presented of the following laser light show effects: a sawtooth wave scan, a triangular wave scan, a sine wave scan, a circular Lissajous pattern, a stationary laser beam on a rotating mirror ball, and a scanning laser bean on a mirror ball. The level of laser radiation of the effect is computed as well as the length of time the effect remains below Class I levels.

18090 (LBL—7485) **Design specifications for a large-volume, DC to 60 Hz, 0.1 TESLA (peak) magnet for primate experimentation.** Tenforde, T.S.; Dols, C.G.; Lake, A.A.; Hay, R.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

Preliminary design specifications and cost estimates are presented for a magnet that would be suitable for both DC and AC field studies with large species of mammals, including nonhuman primates and human subjects. The basic features of this magnet are the following: (1) homogeneous field of variable strength up to 0.1 T can be produced over a 2 ft x 2.5 ft x 4.5 ft (20.25 ft^3) volume; (2) the magnet iron is laminated to minimize eddy current losses when operating in the AC mode; and (3) the power supply is designed to allow controlled frequency variation over the range 0 to 63 Hz, a feature that would permit the detection of frequency thresholds and/or frequency windows for physiological effects such a visual magnetophosphenes.

18091 (LBL—9357) **Magnetic field effects on humans: epidemiological study design. Part II.** Colonias, J.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

A study, designed to investigate the epidemiological health effects resulting from occupational magnetic field exposure produced by various nuclear instruments such as cyclotrons, bubble chambers, and spectrometers was previously described. The methodology involved in determining the magnetic field exposure to such instruments is described here.

18092 (LBL—10056) **Cell growth in a low-intensity, 60 Hz magnetic field.** Kronenberg, S.S.; Tenforde, T.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 33p. Dep. NTIS, PC A03/MF A01.

The growth rate of EMT6 mouse mammary tumor cells was measured during exposure to a 2.3 mT (millitesla^2), 60 Hz magnetic field. The length of the inter-mitotic interval for cultures exposed to the field was found to be identical to that of control cultures. The results of these experiments are described in the context of research

that is being conducted in other laboratories on the effects of magnetic and electric fields on cell growth in vitro.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 18024, 18064, 18086

GEOSCIENCES

18093 (LBL—10349) **Geosciences program annual report 1978.** Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978. Contract W-7405-ENG-48. 59p. Dep. NTIS, PC A04/MF A01.

This report is a reprint of the Geosciences section of the LBL Earth Sciences Division Annual Report 1978 (LBL-8648). It contains summary papers that describe fundamental studies addressing a variety of earth science problems of interest to the DOE. They have applications in such diverse areas as geothermal energy, oil recovery, in situ coal gasification, uranium resource evaluation and recovery, and earthquake prediction. Completed work has been reported or likely will be in the usual channels. (RWR)

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 17418, 17423, 17424, 17437, 17440, 17443, 17444, 17445

18094 (TAC-RS—79-003) **Remote sensing of natural resources. Quarterly literature review, third quarter, July-September 1979.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Dec 1979. 211p. Univ. of New Mexico, Albuquerque, NM.

This bibliography reviews the literature of remote sensing. Documented data and data gathering techniques which are performed or obtained remotely from space, aircraft, or ground-based stations have been selected. All of the documentation is related to remote sensing sensors or the remote sensing of the natural resources. Meteorology and extraterrestrial sensing are normally not selected. Sensors are primarily those operating with the 10-8 to 1 meter wavelength band (ultraviolet through radar). There are exceptions to this when overlapping data is reported, and these have been selected.

18095 Sourcebook of hydrologic and ecological features. Water resource regions of the conterminous United States. Cushman, R.M.; Gough, S.B.; Moran, M.S.; Craig, R.B. Ann Arbor, MI; Ann Arbor Science Publishers, Incorporated (1980). 136p. (DOE/TIC—11137).

This book addresses the hydrologic features (including water quality and use) and aquatic ecological aspects of the forty-eight contiguous United States. Information on the distribution of endangered aquatic species and on the locations of designated wild and scenic rivers is also included. Data are organized by major watersheds - the eighteen water resource regions (WRRs) as defined by the Water Resources Council. We have attempted to high-light salient environs of each region to provide the reader with an impression of the dominant or otherwise important habitats represented. The discussion of hydrologic and ecological features is integrated for each water resource region.

GEOPHYSICS

GEOPHYSICAL SURVEY METHODS

18096 (SAND—79-2026C) **Digital simulation of a seismic system.** Breding, D.R. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 17p. (CONF-800502—8). Dep. NTIS, PC A02/MF A01.

From 26. international instrumentation symposium; Seattle, WA, USA (5 May 1980).

A seismic observatory is currenty under development. The unique features of this observatory are unattended operation, low power, digital output, satellite transmission, and a method of verifying the authenticity of the data received. As a part of the program the analog seismometers and filters were simulated on a computer. A short discussion of digital simulation in general is followed by an explanation of the specific method chosen. The reasons why this simulation was chosen and the accuracy of the simulation is also discussed. Although a specific seismic system is discussed the methods employed apply to analog transfer functions in general. 13 figures.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 17446

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 17652

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 17979

18097 Oceans '77 conference record. Volume 1. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977). 376p. (CONF-7710189—P1).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

Sixteen papers were processed individually.

18098 Oceans '77 conference record. New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977). 440p. (CONF-7710189—P2).

From 3. annual oceans conference; Los Angeles, CA, USA (17 Oct 1977).

Twenty individual papers were processed.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 18297

18099 Solar wind flows associated with hot heavy ions. Fenimore, E.E. (Universiry of California, Los Alamos Scientific Laboratory). *Astrophys. J.;* **235**: No. 1, 245-257(1 Jan 1980).

Solar wind heavy ion spectra measured with the Vela instrumentation have been studied with the goal of determining the solar origins of various solar wind structures which contain anomalously high ionization states. Since the ionization states "freeze-in" close to the Sun, they are good indicators of the plasma conditions in the low and intermediate corona. Heavy ion spectra from three different periods throughout the solar cycle have been analyzed. These data are consistent with freezing-in temperatures ranging from $\sim 1.5 \times 10^6$ K to higher than 9×10^6 K. The spectra indicating hot coronal conditions occur in roughly one-seventh of all measurements and almost exclusively in postshock flows (PSFs), nonshock related helium abundance enhancements (HAEs), or noncompressive density enhancements (NCDEs). The PSFs and HAEs are both probably interplanetary manifestations of solar flares. The observation of several flare-related HAEs which were not preceded by an interplanetary shock suggests that the flare-heated plasma can evolve into the solar wind without producing a noticeable shock at 1 AU. The NCDEs with hot heavy ions differ from the PSF—HAEs in several ways, implying that they evolve from events or places with lower temperatures and less energy than those associated with the flares, but with higher temperatures and densities than the quiet corona. Active regions, coronal mass ejections, and equatorial streamers are possible sources for the NCDEs with spectra indicating hot coronal conditions. These events owe their enhanced densities to coronal processes as opposed to interplanetary dynamical processes. High ionization temperatures are observed almost always in either the NCDEs or the flare-related PSF—HAEs; therefore, if a nonflaring active region evolves into the solar wind with hot heavy ions, it probably evolves into an NCDE.

COSMOLOGY

REFER ALSO TO CITATION(S) 18155

18100 Primordial synthesis of anomalous nuclei. Dicus, D.A.; Teplitz, V.L. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Phys. Rev. Lett.;* **44**: No. 3, 218-221(21 Jan 1980).

We calculate the abundances of anomalous light, $Z>1$ nuclei that would be produced by primordial nucleosynthesis if there exist new neutral, stable baryons.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 18297

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 18191

18101 (GEPP—366a) **Bibliography and author index for electrical discharges in vacuum (1897-1978).** Miller, H.C. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 24 Mar 1980. Contract EY-76-C-04-0656. 250p. Dep. NTIS, PC A11/MF A01.

This bibliography covers the field of electrical discharges in vacuum, comprising both electrical breakdown in vacuum and vacuum arcs. A breif review section lists some review papers which would be helpful to the novice in this field. The bulk of the paper consists of bibliographic listings, arranged by year of publication and within each year, alphabetically by first author. An author index refers one to all papers authored or coauthored by a particular person. There are 2032 papers listed through December 1978.

18102 **Beamlet steering by aperture displacement in ion sources with large acceleration-deceleration ratio.** Conrad, J.R. (Department of Nuclear Engineering, University of Wisconsin, Madison, Wisconsin 53706). *Rev. Sci. Instrum.;* **51**: No. 4, 418-424(Apr 1980).

The steering of ion beamlets by aperture displacement is studied analytically and numerically for the case of triode extractors with large acceleration-deceleration ratios. Here the acceleration-deceleration ratio ϵ is defined by ϵequivalentV/sub a//V/sub b/, where V/sub a/ and V/sub b/ are the potentials applied to the second and third grids of the extractor, relative to the beam forming grid at zero potential. Both slit and round apertures are examined. When the second-order effects of space charge and potential sag in the extractor are included in the analysis, good agreement with numerical simulations is obtained.

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 18108

18103 **Relativistic scattered wave calculations on UF_6.** Case, D.A.; Yang, C.Y. (Department of Chemistry, University of California, Davis, California 95616). *J. Chem. Phys.;* **72**: No. 6, 3443-3448(15 Mar 1980).

Self-consistent Dirac—Slater multiple scattering calculations are presented for UF_6. These are the first such calculations to be reported, and the results are compared critically to other relativistic calculations. The results of all molecular orbital calculations are in good qualitative agreement, as measured by energy levels, population analyses, and spin—orbit splittings. The overall charge distribution is computed to be U/sup +1.5/(F/sup -0.25/)$_6$. Polarization functions are found to be qualitatively unimportant. A detailed comparison is made to the relativistic Xα (RXα) method of Wood and Boring, which also uses multiple scattering theory, but incorporates relativistic effects in a more approximate fashion. For the most part, the RXα results are in excellent agreement with the present results. Some differences of possible significance are noted in the lower valence and core energies.

18104 **Precision isotope shifts for the heavy elements. I. Neutral uranium in the visible and near infrared.** Engleman, R. Jr.; Palmer, B.A. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Opt. Soc. Am.;* **70**: No. 3, 308-317(Mar 1980).

A Fourier transform spectrometer was used to obtain high-resolution spectra of a $^{234}UI_4/^{238}UI_4$ electrodeless discharge lamp. Over 2000 uranium isotope shifts were measured in the visible and near-infrared regions. Level isotope shifts were determined by least squares for 183 odd and 518 even levels of U I with an overall standard deviation of 0.0036 cm^{-1}.

18105 **Energies and lifetimes of excited states in copperlike Kr VIII.** Livingston, A.E.; Curtis, L.J.; Schectman, R.M.; Berry, H.G. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., A;* **21**: No. 3, 771-781(Mar 1980).

The spectrum of Kr VIII has been observed between 180 and 2000 A by using foil excitation of 2.5—3.5-MeV krypton ions. Twenty new transitions have been classified and eleven new excited-state energies have been determined within the n=4 —7 shells. The ionization potential is derived to be 1 015 800 +- 200 cm^{-1}. The excited-state energies and fine structures are compared with recent relativistic Hartree-Fock calculations. The 4p-state lifetime has been measured by performing a simultaneous analysis of decay data for the 4p level and for its dominant cascade-repopulating levels. The 4p lifetime is found to be 30% shorter than previously measured values and is in excellent agreement with the result of a recent multiconfiguration Hartree-Fock calculation. The source of the discrepancy between this result and earlier measurements is discussed.

18106 **Observation of selected molecular-orbital x rays in coincidence with separated-atom K x rays.** O'Brien, J.J.; Liarokapis, E.; Greenberg, J.S. (A. W. Wright Structure Laboratory, Yale University, New Haven, Connecticut 06520). EY-76-C-02-3074. *Phys. Rev. Lett.;* **44**: No. 6, 386-390(11 Feb 1980).

A cascade relationship between molecular-orbital (MO) and separated-atom x rays has been utilized to study selected MO transitions. Depending on the mechanism of vacancy production, the observed MO spectra are interpreted as reflecting $2p\sigma \rightarrow 1s\sigma$ transitions or a mixture of $2p\sigma \rightarrow 1s\sigma$ and $2p\pi \rightarrow 1s\sigma$ transitions. The coincidence selection also directly corroborates a previous assignment of MO transitions to the $2p\sigma$ state.

18107 **Rotational dependence of spin-rotation and hyperfine splittings in the $^2\Sigma$/sub 1/2/ $^+$ ground state of CaF.** Childs, W.J.; Goodman, L.S. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **44**: No. 5, 316-319(4 Feb 1980).

The molecular-beam laser-rf double-resonance technique has been used to make high precision measurements of the spin-rotation and hyperfine interactions in the $v''=0$ vibrational level of the $^2\Sigma$/sub 1/2/ $^+$ ground state of CaF. Both interactions exhibit a strong dependence on N, the rotational quantum number. The details of this N dependence, neither observed nor explicitly predicted previously, are in accord with theory.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 18106

18108 (ORO—5056-T1) **[Exothermicity of atom-molecule reactions: C + NO reaction]. Progress report.** (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 1979. Contract EY-76-S-05-5056. 25p. Dep. NTIS, PC A02/MF A01.

The progress to date on the use of laser induced photoluminescence spectroscopy to determine the quantum state distribution of atom-molecule reactions is reported. Results from the C + NO reaction study are given.

18109 **Schwinger variational principle for electron-molecule scattering: Application to electron-hydrogen scattering.** Watson, D.K.; Lucchese, R.R.; McKoy, V.; Rescigno, T.N. (A. A. Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). W-7405-ENG-48. *Phys. Rev., A;* **21**: No. 3, 738-744(Mar 1980).

The authors report the first application of the Schwinger variational principle to electron-molecule scattering. Results for electron-H_2 scattering in the static-exchange approximation show that the Schwinger method can provide accurate solutions of the scattering problem with small discrete basis sets. The Schwinger variational expression is found to converge far more quickly with respect to the size of the basis than any other algebraic expansion technique considered to date. Results are also presented for hybrid trial scattering wave functions containing both continuum and discrete basis functions.

18110 **Dissociation of F_2 by electron impact excitation of the lowest ^{3}Pi/sub u/ electronic state.** Fliflet, A.W.; McKoy, V.; Rescigno, T.N. (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91125). *Phys. Rev., A;* **21**: No. 3, 788-792(Mar 1980).

An ab initio theoretical study is reported for dissociation of F_2 via excitation of the lowest ^{3}Pi/sub u/ electronic state by electron impact. Differential and integrated cross sections are given for impact energies from 5 to 40 eV. Our distorted-wave model predicts a resonancelike feature in the integrated cross section near threshold with a maximum value of about 0.4 x 10^{-16} cm^2. When target polarization effects are included this feature disappears and the maximum cross section is reduced to about 0.15 x 10^{-16} cm^2.

18111 **Origin of the anomalous enhancement of 180° backscattering yields for light ions in solid targets.** Crawford, O.H. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev. Lett.;* **44**: No. 3, 185-188(21 Jan 1980).

The origin of the enhancement of the near-surface yield of backscattered projectiles at angles close to 180° for swift light ions in solid targets is shown to be a correlation between outgoing and incoming paths which occurs when an ion scatters by almost 180° in one of its collisions in a solid. The theory does not invoke the crystal structure, or the disturbance of the medium by the ion. Calculations agree with experiment for 1-MeV He^{++} in Pt.

ATOMIC AND MOLECULAR THEORY

18112 Comments on near-zero-energy resonances in atoms in external fields. Rau, A.R.P.; Lu, K.T. (Physics Department, Yale University, New Haven, Connecticut 06520). *Phys. Rev., A;* **21**: No. 3, 1057-1060(Mar 1980).

Recent papers have presented data on the high Rydberg states of rubidium in external electric fields. We present an analysis which accounts for the energy positions and symmetry aspects of the resonances seen in these experiments. Our analysis places these new data in the framework of previous studies of such resonances.

GENERAL FLUID DYNAMICS

18113 Partial chemical equilibrium in fluid dynamics. Ramshaw, J.D. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Fluids;* **23**: No. 4, 675-680(Apr 1980).

An analysis is given for the flow of a multicomponent fluid in which an arbitrary number of chemical reactions may occur, some of which are in equilibrium while the others proceed kinetically. The primitive equations describing this situation are inconvenient to use because the progress rates omega-dot/sub s/ for the equilibrium reactions are determined implicitly by the associated equilibrium constraint conditions. Two alternative equivalent equation systems that are more pleasant to deal with are derived. In the first system, the omega-dot/sub s/ are eliminated by replacing the transport equations for the chemical species involved in the equilibrium reactions with transport equations for the basic components of which these species are composed. The second system retains the usual species transport equations, but eliminates the nonlinear algebraic equilibrium constraint conditions by deriving an explicit expression for the omega-dot/sub s/. Both systems are specialized to the case of an ideal gas mixture. Considerations involved in solving these equation systems numerically are discussed briefly.

PROPERTIES AND STRUCTURE OF FLUIDS

18114 Mechanism of pulsed surface flashover involving electron-stimulated desorption. Anderson, R.A.; Brainard, J.P. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP-00789. *J. Appl. Phys.;* **51**: No. 3, 1414-1421(Mar 1980).

A simple model is proposed to explain how a breakdown avalanche of secondary emission electrons can lead to surface flashover when an insulator in vacuum breaks down a few nanoseconds after high voltage is applied. The case of a plane insulator—vacuum interface perpendicular to parallel electrodes is considered. Positive surface charging is assumed to occur almost immediately upon application of the voltage, and the attendent secondary emission avalanche is assumed to be maintained at saturation throughout the prebreakdown time delay by field emission from the cathode electrode. Bombardment of the insulator by avalanche electrons desorbs a cloud of gas, which is partially ionized as it drifts through the swarm of electrons in the avalanche. The electric field at the cathode end of the insulator becomes enhanced as positive ions accumulate, which in turn increases the field emission and the rates of gas desorption and ionization. This and other regenerative processes rapidly lead to breakdown. Field enhancement at the cathode end of the insulator and increased field emission are individually considered in determining the prebreakdown time delay, with very similar results. The model predicts a time delay of the order of 10 ns at E=10 MV/m, which is in reasonable agreement with experimental observations. The proportionality we have observed between the time delay and the inverse square of the applied voltage is also predicted, as well as a dependence of the time delay on the insulator length. The model may also account for the improved performance of insulators coated with certain metal oxides.

MAGNETOHYDRODYNAMICS

18115 MHD electrical potentials: Uniqueness of solutions to an extended class of elliptic boundary value problems. Sacks, R.A. (Science Applications, Oak Brook, Illinois 60521). *J. Appl. Phys.;* **51**: No. 3, 1407-1409(Mar 1980).

The electrostatic potential describing the fields interior to a magnetohydrodynamic (MHD) power generating channel obeys a linear uniformly elliptic partial differential equation. The physically natural boundary conditions, however, do not fall within a class for which the solution has previously been shown to be unique. We discuss the boundary conditions appropriate to this situation and then generalize the discussion in Courant and Hilbert to demonstrate the uniqueness of the solution to an extended class of boundary value problems which includes the MHD channel as a special case.

SUPERFLUIDITY

18116 Excitations in few-atomic-layer adsorbed helium films: The two-dimensional roton. Thomlinson, W.; Tarvin, J.A.; Passell, L. (Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev. Lett.;* **44**: No. 4, 266-269(28 Jan 1980).

Inelastic neutron scattering from helium adsorbed on Graphon indicates the presence of two types of excitations: one bulklike, which appears to be associated with the normal density part of the film; and a second, at lower energy, which is thought to originate in the high-density liquid layer immediately adjacent to the solid layers of the film. The latter is believed to be responsible for the reduced roton gap inferred from bulk studies of few-atomic-layer superfluid films.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

18117 (DOE/EY/02232A—84) Experimental studies of elementary particle interactions at high energies. Technical progress report. Cool, R.L. (Rockefeller Univ., New York (USA)). Jan 1980. Contract EY-76-C-02-2232. 27p. Dep. NTIS, PC A03/MF A01.

High energy physics research at Rockefeller University is discussed. Results of e^+e^- pairs experiments at the CERN ISR are summarized along with particles associated with high p/sub T/ π^0 triggers and direct single γ rays. (GHT)

ELECTROMAGNETIC INTERACTIONS

18118 (ANL-HEP-CP—80-01) Spin measurements in nucleon-nucleon scattering up to 12 GeV/c, and present status of many dinucleon resonances. Yokosawa, A. (Argonne National Lab., IL (USA)). 8 Jan 1980. Contract W-31-109-ENG-38. 35p. (CONF-791174—1). Dep. NTIS, PC A03/MF A01.

From Meeting on two-nucleon systems and dibaryon resonances; Hiroshima, Japan (Nov 1979).

The processes of proton-proton scattering for various spin directions have been investigated in the beam momentum range of 1 to 12 GeV/c. Various pp scattering parameters have been measured at 6 GeV/c, including three-spin parameters, which are sufficient to determine pp elastic scattering amplitudes in a model-independent way at $0.2 < /t/ < 0.8$ $(GeV/c)^2$. Measurements of spin-spin correlation parameters have been extended to higher t and higher energies, revealing the importance of the spin-dependent interaction. These measurements may shed light on the nature of the constituents and their interactions. Diproton resonances in the mass region 2100 to 2800 MeV were discussed during the last Hiroshima meeting (1978). Here are presented a number of candidates for I = 0 and I = 1 dinucleon resonances and summarized various evidence for the existence of resonances.

18119 (SLAC—223) Decays of the psi'(3684) to other charmonium states. Himel, T.M. (Stanford Linear Accelerator Center, CA (USA)). Oct 1979. Contract EY-76-C-03-0515. 123p. Dep. NTIS, PC A06/MF A01.

An experimental study of the decays of the psi'(3684) to other charmonium states is reported. The decays of 10^6 psi'(3684)'s were observed with the SLAC-LBL Mark II detector at the e^+e^- storage ring SPEAR. Branching ratios have been measured for psi'(3684) decays to γ chi where the chi decays to γ psi(3095) or to hadrons. An upper limit of 0.13% is set on the branching ratio for psi' $\rightarrow \gamma$ chi(3455) $\rightarrow \gamma\gamma$ psi(3095); this is a factor of 6 less than the branching ratio measured by a previous less sensitive experiment. The decay psi' $\rightarrow \gamma$ eta/sub c/, eta/sub c/ $\rightarrow$ hadrons is investigated. The decay psi' $\rightarrow \pi^0$psi, which violates isospin conservation, is observed with a branching ratio of (0.15+-0.06)%.

18120 Evidence for direct γ production at large x in psi (3100) decay. Ronan, M.T.; Trippe, T.G.; Barbaro-Galtieri, A.; Ely, R.; Feller, J.M.; Fong, A.; Gobbi, B.; Lecomte, P.; Litke, A.M.; Maderas, R.J.; Miller, D.H.; Parker, S.I.; Pun, T.P.; Ross, R.R.; Vuillemin, V.; Yount, D.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). W-7405-ENG-48;EY-76-C-03-0515. *Phys. Rev. Lett.;* **44**: No. 6, 367-370(11 Feb 1980).

The inclusive γ and π^0 momentum spectra from psi (3100) decay have been measured in e^+e^- annihilation at SPEAR. When the γ spectrum is compared with that expected from π^0 decay, an excess of high-momentum γ's is observed. This excess is compared with that predicted by quantum chromodynamics for the decay of the psi into a γ and two gluons.

WEAK INTERACTIONS

18121 Dimuon production by neutrinos in the Fermilab 15-foot bubble chamber. Ballagh, H.C.; Bingham, H.H.; Fretter, W.B.;

Lawry, T.; Lynch, G.R.; Lys, J.; Marriner, J.P.; Orthel, J.; Sokoloff, M.D.; Stevenson, M.L.; Yost, G.P.; Chrisman, B.; Gee, D.; Greene, A.; Harigel, G.; Huson, F.R.; Murphy, T.; Schmidt, E.; Smart, W.; Treadwell, E.; Wolfson, J.; Cence, R.J.; Harris, F.A.; Jones, M.D.; Parker, S.I.; Peters, M.W.; Peterson, V.Z.; Burnett, T.H.; Fluri, L.; Holmgren, D.; Lubatti, H.J.; Moriyasu, K.; Rees, D.; Rudnicka, H.; Swider, G.M.; Wolin, E.; Benada, R.; Camerini, U.; Duffy, M.; Fry, W.; Loveless, R.J.; McCabe, P.; Reeder, D.D. (Department of Physics and Lawrence Berkeley Laboratory, University of California at Berkeley, Berkeley, California 94720). *Phys. Rev., D;* **21**: No. 3, 569-579(1 Feb 1980).

In a 326 000-picture exposure of the Fermilab 15-ft neon-hydrogen bubble chamber to the quadrupole triplet neutrino beam, 62 dimuon candidates have been found: 0 $\mu^+\mu^+$, 54 $\mu^-\mu^+$ and $\mu^+\mu^-$, and 8 $\mu^-\mu^-$. The $\mu^-\mu^-$ candidates are consistent with background. The ratio of opposite-sign dimuon events to single-muon events is $(0.39 \pm 0.10) \times 10^{-2}$ for a muon-momentum cut of 4 GeV/c. There are 10 V^0's in the opposite-sign dimuon events, yielding a neutral-strange-particle rate per event of 0.6 ± 0.3.

18122 Measurement of the K⁺/sub mu3/ decay spectrum and form factors. Whitman, R.; Abrams, R.J.; Carroll, A.S.; Kycia, T.F.; Li, K.K.; Michael, D.N.; Mockett, P.M.; Rubinstein, R.; Wattenberg, A. (University of Illinois at Chicago Circle, Chicago, Illinois 60680). *Phys. Rev., D;* **21**: No. 3, 652-662(1 Feb 1980).

The Dalitz-plot density of a sample of 3973 K⁺/sub mu3/ decays in flight at 1.8 GeV/c ($K^+ \to \pi^0\mu^+\nu$/sub μ/) was studied to determine λ/sub +/ and λ_0, the linear coefficients of the t dependence of the vector and scalar form factors, where t is the four-momentum transfer to the lepton pair. The μ^+ was detected by scintillator hodoscopes, identified by thick-plate optical spark chambers and momentum analyzed in a magnetic spectrometer. The π^0 was detected by its decay into two γ's which converted in a lead—optical-spark-chamber—scintillator sandwich detector. The measured coefficients were λ/sub +/$=0.050 \pm 0.013$ and $\lambda_0=0.029 \pm 0.011$. The chi² of the fit was 63 for 57 degrees of freedom.

18123 Measurement of high-energy direct photons in psi decays. Abrams, G.S.; Alam, M.S.; Blocker, C.A.; Boyarski, A.M.; Briedenbach, M.; Burke, D.L.; Carithers, W.C.; Chinowsky, W.; Coles, W.W.; Cooper, S.; Dieterle, W.E.; Dillon, J.B.; Dorenbosch, J.; Dorfan, J.M.; Eaton, M.W.; Feldman, G.J.; Franklin, M.E.B.; Gidal, G.; Goldhaber, G.; Hanson, G.; Hayes, K.G.; Himel, T.; Hitlin, D.G.; Hollebeek, R.J.; Innes, W.R.; Jaros, J.A.; Jenni, P.; Johnson, A.D.; Kadyk, J.A.; Lankford, A.J.; Larsen, R.R.; Lueth, V.; Millikan, R.E.; Nelson, M.E.; Pang, C.Y.; Patrick, J.F.; Perl, M.L.; Richter, B.; Roussarie, A.; Scharre, D.L.; Schindler, R.H.; Schwitters, R.F.; Siegrist, J.L.; Strait, J.; Taureg, H.; Tonutti, M.; Trilling, G.H.; Vella, E.N.; Vidal, R.A.; Videau, I.; Weiss, J.M.; Zaccone, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515;W-7405-ENG-48. *Phys. Rev. Lett.;* **44**: No. 3, 114-118(21 Jan 1980).

The inclusive γ and π^0 momentum distributions at the psi have been measured. Using these data and estimates of eta production, it is found that (4.1 ± 0.8) % of psi decays contain a direct photon with energy greater than 60% of the beam energy. The expected momentum distribution for direct photons calculated to lowest order in quantum chromodynamics is qualitatively different from that observed in the data.

STRONG BARYON-INDUCED INTERACTIONS

18124 Inclusive Δ^{++} production in pp, K^+p, π^+p, and π^-p interactions at 147 GeV/c. Brick, D.; Shapiro, A.M.; Widgoff, M. (Brown University, Providence, RI 02912). *Phys. Rev., D;* **21**: No. 3, 632-640(1 Feb 1980).

We have studied inclusive Δ^{++} production at 147 GeV/c in pp, K^+p, π^+p, and π^-p interactions. All four reactions were detected with the same apparatus and analyzed in the same way. The energy dependence of the Δ^{++} cross section was found to be $Ap^{-1}+B$ for pp, K^+p, and π^+p interactions and constant for π^-p interactions. The shape of the inclusive Δ^{++} distributions does not depend on the beam, while the magnitudes are proportional to the total cross sections. We have obtained the effective trajectory at the $p\text{-}\Delta^{++}$ vertex from a triple-Regge analysis and found that all results are consistent with predictions of a triple-Regge diagram where a Pomeron is exchanged at the beam vertex and a π at the target vertex.

18125 Observation of inclusive ω production at large transverse momentum. Donaldson, G.J.; Gordon, H.A.; Lai, K.; Barnes, A.V.; Mellema, D.J.; Tollestrup, A.V.; Walker, R.L.; Dahl, O.I.; Johnson, R.A.; Ogawa, A.; Pripstein, M.; Shannon, S.R. (Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., D;* **21**: No. 3, 828-830(1 Feb 1980).

We have observed the production of ω mesons at large transverse momentum produced in 200-GeV/c pBe interactions. The ratio of inclusive production of ω to π^0 at transverse momenta above 2.2 GeV/c is 0.44 ± 0.08 near x=0. The upper limit for eta' to eta production is <1.4 in the same kinematic region.

18126 Prompt muon production at small X/sub F/ and P/sub T/ in 350-GeV p-Fe collisions. Ritchie, J.L.; Bodek, A.; Coleman, R.N.; Marsh, W.; Olsen, S.; Barish, B.C.; Messner, R.L.; Shaevitz, M.H.; Siskind, E.J.; Fisk, H.E.; Fukushima, Y.; Donaldson, G.; Merritt, F.S.; Wojcicki, S.G. (University of Rochester, Rochester, New York 14627). *Phys. Rev. Lett.;* **44**: No. 4, 230-233(28 Jan 1980).

Total prompt muon production rate for muons with P/sub lab/>8 GeV has been measured in 350-GeV p-Fe collisions. A promt rate of $(3.29 \pm 0.45) \times 10^{-4}$ per collision is determined, yielding $\mu/\pi = (0.93 \pm 0.13) \times 10^{-4}$. The μ/π ratio des not show the rise at small X/sub F/ and small P/sub T/ seen in intersecting-storage-ring electron/π measurements. A charm production cross section of 22 ± 9 μb/nucleon is extracted from the contributions of prompt single muons to the total prompt rate.

18127 Correlations between high-momentum mesons in $p+p \to \pi+\pi+X$ at s/sup 1/2/=63 GeV. Bobbink, G.J.; van Driel, M.A.; Erne, F.C.; Langeveld, W.G.J.; Kooijman, P.M.; Sens, J.C.; Timmer, J.; Favart, D.; Leleux, P.; Block, M.M.; Campanini, R.; Ludwig, H.W.; Botje, M.A.; van Wezep, D. (National Institute for Nuclear and High Energy Physics, Amsterdam, The Netherlands). *Phys. Rev. Lett.;* **44**: No. 3, 118-121(21 Jan 1980).

In pp collisions at $\sqrt{s}=62.3$ GeV where each proton fragments into at least one low p/sub T/, high-x pion, no significant correlations for $\pi^+\pi^+$, $\pi^+\pi^-$ and $\pi^-\pi^-$ are found, thus excluding quark exchange with Brodsky-Gunion counting rules as the dominant interaction mechanism. This, together with the experimental x dependence of single-particle spectra, suggests the introduction of a new counting rule, which is discussed.

18128 Inclusive π^0 production over large X/sub perpendicular/ and X/sub F/ ranges in 200-, 300-, and 400-GeV/c proton-beryllium interactions. Baltrusaitis, R.M.; Binkley, M.; Cox, B.; Kondo, T.; Murphy, C.T.; Yang, W.; Ettlinger, L.; Goodman, M.S.; Matthews, J.A.J.; Nagy, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **44**: No. 3, 122-125(21 Jan 1980).

Measurements of recognized π^0 production in p-Be collisions for $0.1<$X/sub perpendicular/<0.5 and $-0.8<$X/sub F/<0.0 at 200, 300, and 400 GeV/c are presented. These invariant cross sections are fitted by E dσ/dp^3=A (1-X/sub R/)/sup M/P/sub perpendicular/ /sup -N/ over this range of X/sub perpendicular/ and X/sub F/ with $M=4.88 \pm 0.14$ and $N=8.90 \pm 0.10$ independent of energy. No significant evidence for breaking of this scaling is observed over this large kinematic region at these energies.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 18124

18129 High-statistics measurement of polarization in $\pi^-p \to K^0\Lambda$ at 3 and 5 GeV/c. Snyder, A.; Ambats, I.; Meyer, W.T.; Musgrave, B.; Phelan, J.J.; Rest, J.; Ward, C.E.W.; Yuta, H. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., D;* **21**: No. 3, 599-606(1 Feb 1980).

We have measured the polarization of the Λ hyperon produced in the reaction $\pi^-p \to K^0\Lambda$ at 3 and 5 GeV/c, for four-momentum transfers t' out to 1.6 GeV², by observing the parity-violating decay $\Lambda \to p\pi^-$. With an increase in statistical power by a factor of 3 to 4 over the best previous experiments in this energy range, we confirm earlier observations that the polarization is small and positive below t'=0.4 GeV², becoming large and positive for larger values of t'. In particular, at 5 GeV/c for all t' between 0.8 and 1.6 GeV² the polarization is consistent with a value of -1.

18130 Neutral three-pion resonance production in 15-GeV/c π^+-deuteron collisions. Bugg, W.M.; Condo, G.T.; Handler, T.; Hart, E.L.; Cohn, H.O.; Hagopian, S.; Hagopian, V.; Lannutti, J.E. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37916). *Phys. Rev., D;* **21**: No. 3, 623-627(1 Feb 1980).

The production of $\pi^+\pi^-\pi^0$ events allows the study of pure I=1 exchange without the complicating presence of the Δ (1236) which appears with proton targets. A total of 4218 events, corresponding to 8.5 events/μb, were analyzed from an exposure of the SLAC 82-inch deuterium bubble chamber. The low-mass resonances [eta, ω, A_2, and ω (1675)] are clearly observed. In addition, enhancements due to possible higher-mass resonances are observed by using the technique of p/sub perpendicular/ cuts.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 18162

18131 Do bound color-octet states of liberated quarks exist?. Lipkin, H.J. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., D;* **21**: No. 3, 850-852(1 Feb 1980).

In models where quarks are liberated and color can be excited, the three-quark color-octet state is shown to be unbound and unstable against breakup into free quarks and diquarks. The signature for color excitation in deep-inelastic processes should not be a bound three-quark state which decays electromagnetically but a final state containing free quarks.

ELECTROMAGNETIC INTERACTIONS

18132 (CONF-800131—38) Microscopic analysis of pion-nucleus inelastic scattering. Lee, T.S.H. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG—1. 12p. Dep. NTIS, PC A02/MF A01.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

Theoretical methods of analyzing pion-nucleus inelastic scattering with energy near the (3,3) resonance are reviewed. It is illustrated that the DWIA in momentum space has provided a reasonable tool to reveal microscopically the structure of nuclear states from the existing data.

18133 Comparison of gauge-model predictions at high Q^2: pp, p-barp, and e^+e^- interactions. Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **21**: No. 5, 1214-1223(1 Mar 1980).

We compare the predictions of the SU/sub L/(2) x U(1) and SU/sub L/(2) x SU/sub R/(2) x U(1) gauge models for various pp, p-barp, and e^+e^- processes at high Q^2. First, we calculate the masses, total widths, and branching ratios for the various neutral (Z^0) gauge bosons in both models to show their parameter dependence. We then calculate their production cross sections for pp, p-barp, and e^+e^- interactions. Further, we consider the forward-backward asymmetry and the polarization effects in e^+e^- annihilation for both models. We find that the best and perhaps the only way to distinguish the two models is to search for a second Z^0 boson in leptonic and hadronic reactions. The detection of such a particle may be possible with the next generation of accelerators.

18134 Constraints on charged-Higgs-boson couplings. Abbott, L.F.; Sikivie, P.; Wise, M.B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., D;* **21**: No. 5, 1393-1403(1 Mar 1980).

Using the experimental value of the K/sub L/-K/sub S/ mass difference, we derive constraints on charged-Higgs-boson couplings in gauge theories of the weak and electromagnetic interactions. These bounds severely restrict the possible magnitude of charged-Higgs-boson effects in K and D meson decays. Our results are based on the observation that charged-Higgs-boson-exchange contributions to K^0-K-bar^0 mixing are of order $1/M/\text{sub } H/^2$ whereas the corresponding W-boson contribution is only of order $m/\text{sub } c/^2/M/\text{sub } W/^4$.

18135 Magnetic properties of the low-lying hadrons. Geffen, D.A.; Wilson, W. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). EY-76-C-02-1764. *Phys. Rev. Lett.;* **44**: No. 6, 370-374(11 Feb 1980).

It is proposed that the effective magnetic moment of quarks in hadrons should have an anomalous moment contribution because of the magnetic coupling of the photon to three or more gluons. We estimate this nonperturbative effect phenomenologically and find strong evidence for it from the measured decay rates $V \to P + \gamma$ and the observed magnetic moments of baryons.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 18134

18136 Dynamical effects in two-body charm decay. Donoghue, J.F.; Holstein, B.R. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EC-76-C-02-3069. *Phys. Rev., D;* **21**: No. 5, 1334-1341(1 Mar 1980).

Two-body nonleptonic decays of the D (1865) mesons are studied. Three mechanisms: quark-mass-dependent effects, final-state interactions, and mixing-angle effects in the six-quark model: are shown to have the capability to substantially modify naive theoretical expectations for SU(3) and quark-model relations among the various modes.

18137 Determination of quark-nucleon inclusive cross section from leptoproduction of hadrons in nuclear targets. Bialas, A.; Bialas, E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **21**: No. 3, 675-684(1 Feb 1980).

The A dependence of hadron leptoproduction from nuclear targets is interpreted as a measurement of inclusive inelastic and possibly also quasielastic quark-nucleon cross sections. The formulas which allow us to extract these cross sections from the data are derived and discussed. Numerical estimates indicate that the measurement of the total inelastic quark-nucleon cross section is perfectly feasible. Measurement of differential inclusive cross sections of the reaction quark+nucleon → quark+anything is possible as well but requires experiments with rather high statistics. Implications of our calculations for the process of heavy-lepton pair production from nuclear targets are also briefly discussed.

18138 Phenomenology of the next sequential lepton. Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., D;* **21**: No. 3, 706-710(1 Feb 1980).

We consider the phenomenology of a sequential, charged lepton in the mass range 6 —13 GeV. We find the semileptonic branching ratio of such a lepton to be ~ 13%; the dominant two-body modes are found to include the decay $L \to \nu/\text{sub } L/F^*$ with a branching ratio ~ 6%. In this analysis we assume that the mass of the lepton under consideration is lighter than the t quark such that decays such as $L \to \nu/\text{sub } L/t\text{-barq}$, where q= (d, s, or b) are kinematically forbidden. We also find that decays such as $L \to \nu/\text{sub } L/B^*$ (c-barb) can also be as large as ~ 6% depending on the mixing angles; the lifetime of such a lepton is found to be ~ $2.6 \times 10^{-13} M/\text{sub } L/^{-5}$ sec, where M/sub L/ is in GeV.

18139 Cabibbo-suppressed nonleptonic D decays. Abbott, L.F.; Sikivie, P.; Wise, M.B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., D;* **21**: No. 3, 768-771(1 Feb 1980).

We discuss why an extension of the ideas used to explain the $\Delta I = 1/2$ rule in kaon and hyperon decays does not lead to an analogous large enhancement in the rates of Cabibbo-suppressed nonleptonic D-meson decays. The possibility of seeing the contribution of diagrams with a virtual b-quark loop through interference effects is also discussed.

18140 No contradiction in nonleptonic decays of D mesons. Katuya, M. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *Phys. Rev., D;* **21**: No. 3, 827(1 Feb 1980).

We point out that there is no contradiction among the uniformly populated Dalitz plot for $D^+ \to \pi^+\pi^+K^-$ decay, a relation derived b, applying the soft-pion theorem to its amplitude, and the new experimental data on B ($D^0 \to \pi^0$K-bar^0)/B ($D^+ \to \pi^+\pi^+K^-$) and tau (D^+)/tau (D^0).

18141 Nonspectator quark interactions and the $\Lambda/\text{sub } c/^+$ lifetime. Barger, V.; Leveille, J.P.; Stevenson, P.M. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). EY-76-C-02-0881;COO-881-115. *Phys. Rev. Lett.;* **44**: No. 4, 226-229(28 Jan 1980).

It is found that nonspectator interactions between c and d quarks in the $\Lambda/\text{sub } c/^+$ give a substantial enhancement of its decay rate. The lifetime relation tau ($\Lambda/\text{sub } c/^+$)/tau (D^+) = 1+tau (D^+)/(3×10^{-13}s)]$^{-1}$ is derived, based on the assumption that the D^+ decays purely via charm quark decay. The semileptonic branching fractions are related by B/sub l/($\Lambda/\text{sub } c/^+$) = B/sub l/(D^+) tau ($\Lambda/\text{sub } c/^+$)/tau (D^+).

18142 Conflict between natural flavor conservation of Higgs couplings and Cabibbo mixing in SU(2)/sub L/ x U (1). Segre, G.; Arthur Weldon, H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). EY-76-C-02-3071. *Ann. Phys. (N.Y.);* **124**: No. 1, 37-60(Jan 1980).

The general problem of conservation of strangeness and other quark flavors by the exchange of several neutral Higgs mesons is investigated in SU (2)/sub L/ x U (1). We find that the horizontal symmetries necessary to enforce this conservation conflict with the known Cabibbo mixing. In particular, if the quarks form an irreducible representation of the horizontal symmetry, the mixing angles are all trivial (i.e. 0 or $\pi/2$); if they form a reducible representation, it is possible to have some nontrivial mixing angles, but only if there are several unmixed generations of quarks with exactly the same relative pattern of masses and mixings.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 18160

18143 Model for inclusive a+b → c+X with ac-bar exotic. Desai, B.R.; Shen, B.C. (Department of Physics, University of California, Riverside, California 92521). *Phys. Rev., D;* **21**: No. 5, 1313-1315(1 Mar 1980).

A model is proposed for inclusive a+b → c+X for ac-bar exotic in terms of the Mueller-Regge framework involving a+b+c-bar → a+b+c-bar where the central Pomeron—c-particle amplitude is approximated by the c-particle propagator. In terms of a simple form-factor cutoff parametrization for the c-particle propagator, excellent agreement is obtained with the experimental data on inclusive production of phi and psi. It is argued that even when ac-bar is not exotic our model is applicable as long as t and u are large.

18144 Study of parton transverse momentum using jets from hadron interactions. Corcoran, M.D.; Erwin, A.R.; Thompson, M.A.; Cormell, L.; Dris, M.; Kononenko, W.; Robinson, B.; Selove, W.; Yost, B.; Kanofsky, A.; Gollon, P.J. (University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D;* **21**: No. 3, 641-651(1 Feb 1980).

We study the momentum unbalance in two-jet events which we have obtained with a two-arm calorimeter array at Fermilab. Although the unbalance is relatively sharply peaked near zero, the rms unbalance is considerably greater than that due to instrumental effects alone. We interpret the unbalance as being principally due to effects of parton transverse momentum K/sub T/. We give results for the resolution-corrected rms unbalance (approximately equal to K/sub T/) for a range of values of jet p/sub T/. pp collisions are studied at three s values, and π^+ p collisions are compared with them at two of these s values. The results are compared with information on K/sub T/ obtained from other experiments, principally experiments on dimuon production. Implications of the similarities and of the differences are discussed.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 18133

18145 Multiquark states. II. QQ-bar and $Q^2Q\text{-bar}^2$ mesons. Aerts, A.T.; Mulders, P.J.; de Swart, J.J. (Institute for Theoretical Physics, University of Nijmegen, The Netherlands). *Phys. Rev., D;* **21**: No. 5, 1370-1387(1 Mar 1980).

In the previous paper we proposed a phenomenological mass formula based on the MIT bag model. We used it to describe the spectrum of baryon resonances. Now it is applied to the QQ-bar and $Q^2Q\text{-bar}^2$ states. Using the results for the QQ-bar meson spectrum we are able to perform a parameter-free calculation of the $Q^2\text{-}Q\text{-bar}^2$ (baryonium) spectrum. The other orbitally excited $Q^2Q\text{-bar}^2$ configurations are also studied. We find natural interpretations for the narrow NN-bar resonances, e.g., for the S (1936), which we predict to have J/sup P/C=2^{--} and I=0, 1, and 2 components.

STRONG INTERACTIONS, BARYON NO.=1

18146 Pion-nucleon phase-shift analyses: 0—350 MeV. Zidell, V.S.; Arndt, R.A.; Roper, L.D. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Phys. Rev., D;* **21**: No. 5, 1255-1288(1 Mar 1980).

Energy-dependent and energy-independent partial-wave analyses of the low-energy π^{+-} p elastic and charge-exchange scattering data are presented. Unique, unitary, energy-dependent solutions giving a chi²/datum of 1 are obtained. The solutions exhibit charge splitting in both the S_{31} and P_{33} partial waves. The T-matrix pole positions and residues of the Δ^{++} and Δ^0 resonances are determined to a new precision. D and F waves are well determined independent of theoretical constraints. New values for the S- and P-wave scattering lengths and effective ranges are reported.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 18133, 18167

18147 Comment on the possibility of narrow structure in σ/sup tot/(pp) at medium energy. Fields, T.H.; Yokosawa, A. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Phys. Rev., D;* **21**: No. 5, 1432-1433(1 Mar 1980).

The possibility that dibaryon resonant states, of the type proposed recently by MacGregor, might be detected as narrow peaks in the pp total cross section is discussed.

18148 Very-high-energy antiproton physics: Colliding 1-TeV "antiquarks" on heavy nuclei. Halzen, F.; McIntyre, P. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Phys. Rev., D;* **21**: No. 3, 726-732(1 Feb 1980).

Dorfan et al. demonstrated experimentally that one can extend the mass range of an accelerator by using the Fermi motion of nucleons inside heavy nuclear targets. The development of antiproton sources and intense pion beams at Fermilab and CERN makes possible a dramatic enhancement of this mechanism. We show that the increase in threshold production using antiprotons or pions rather than protons far exceeds the loss in luminosity. Furthermore, by using antiprotons in an internal-target experiment, the modest instantaneous rates and large signal/background ratio permit detailed study of the final state.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

REFER ALSO TO CITATION(S) 18133

18149 Tests of the fermion and Higgs multiplet structure of the SU(2) x U(1) model. Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., D;* **21**: No. 5, 1404-1409(1 Mar 1980).

We try to analyze the possible representation content of the fermion and Higgs sectors of the SU(2) x U(1) model by using several different kinds of constraints such as universality of charged currents, gauge invariance, and the present neutral-current data. Our analysis highly favors the assignment of u/sub L/ and d/sub L/ (and, separately, ν/sub L//sup e/ and e/sub L/) to a doublet although multiplets with possibly higher values of weak isospin cannot be completely ruled out. Various other tests are discussed.

18150 Light-fermion mass hierarchy and grand unification. Barr, S.M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). EY-76-C-02-3071. *Phys. Rev., D;* **21**: No. 5, 1424-1427(1 Mar 1980).

We show that the existence of a hierarchy of masses among light fermions, with typical mass ratios (α/π) (where α is the unified gauge coupling at the unification mass scale), is a natural feature of a certain class of grand unification schemes that have recently been discussed.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 18142, 18152, 18179

APPLICATIONS TO STRONG INTERACTIONS

18151 Explicit one-loop corrections to the strong CP-violating phase in SU(2)/sub L/ x U(1). Goffin, V.; Segre, G.; Weldon, H.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). EY-76-C-02-3071. *Phys. Rev., D;* **21**: No. 5, 1410-1423(1 Mar 1980).

In a CP-invariant Lagrangian the spontaneous symmetry breaking that generates the quark mass matrix m will induce CP violations into the strong interactions with strength θ/sub QFD/ =arg Detm, where QFD refers to quantum flavor dynamics. Even if Detm is real in tree approximation, it will generally not be in higher order. We show that in any SU(2)/sub L/ x U(1) model the only one-loop corrections to θ/sub QFD/ come from Higgs particles. These are explicitly calculated in a six-quark model with permutation symmetry. We find θ/sub QFD/ ≅ 10^{-10}(m/sub s//m/sub b/)(m/sub t//m/sub b/)² in one case and θ/sub QFD/ ≅ 10^{-8}(m/sub c//m/sub t/) in a second case. Cabibbo angles and CP violation in the kaon system are also examined.

FIELD THEORY

REFER ALSO TO CITATION(S) 18120, 18123, 18131, 18134, 18135, 18136, 18142, 18144, 18149, 18151

18152 Can SU(2)/sub L/ x U(1) and SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge theories be distinguished at high Q^2?. Rizzo, T.; Sidhu, D.P. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., D;* **21**: No. 5, 1209-1213(1 Mar 1980).

It is known that the low-energy weak-interaction experiments do not distinguish between the standard SU(2)/sub L/ x U(1) and SU(2)/sub L/ x SU(2)/sub R/ x U(1) gauge theories. In this paper, we investigate the question of distinguishability of the two classes of gauge theories in high-Q^2 weak-interaction experiments which are planned for the future.

18153 Are instantons found?. Callan, C.G. Jr.; Dashen, R.F.; Gross, D.J. (Princeton University, Princeton, New Jersey 08540). EY-76-02-2220. *Phys. Rev. Lett.;* **44**: No. 7, 435-438(18 Feb 1980).

It is argued that the recent prediction of the a dependence of the coupling, g (a), of an effective lattice gauge theory for quarkless qauntum chromodynamics is confirmed by a recent numerical evaluation of g (a) for a latticized SU(2) gauge theory, thus providing strong evidence for the dynamical role of instantons. Additional predictions, testing the validity of the quantum chromodynamics bag model, are presented.

18154 Determination of the quark decay function without phenomenological input. Chang, V.; Hwa, R.C. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). EY-76-S-06-2230. *Phys. Rev. Lett.;* **44**: No. 7, 439-442(18 Feb 1980).

On the basis of quantum chromodynamics (QCD) and the recombination model the quark decay function is calculated. The inclusive distribution for a quark and an antiquark in a quark jet can be determined by the perturbative method in QCD. The hadronization of quarks and antiquarks is described by a recombination function that is completely fixed in a recent study of the structure function. No free parameters are involved and the agreement with the data is excellent.

18155 Synthesis of baryons from unconfined quarks. Dicus, D.A.; Pati, J.C.; Teplitz, V.L. (Center for Particle Theory, University of Texas, Austin, Texas 78712). *Phys. Rev., D;* **21**: No. 4, 922-927(15 Feb 1980).

We calculate, for a number of cases, the cosmic temperature at which primordial quarks condense into baryons, within a field theory of partially confined quarks that enjoys temporary asymptotic freedom. We assume that the mass of a quark in a dense quark-antiquark medium is a monotonic function of the medium: that is, we assume the validity of the so-called "Archimedes effect." We show that, within such models, unbound-quark lifetimes are larger than the age of the universe at the time of the transition.

18156 Group weight and vanishing graphs. Butera, P.; Cicuta, G.M.; Enriotti, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., D;* **21**: No. 4, 972-978(15 Feb 1980).

Various properties of the group weight of Feynman graphs in non-Abelian gauge theories are discussed. Infinitely many skeleton graphs with vanishing weight are exhibited for every compact Lie group. The $1/N^2$ dependence of the topological expansion is related to a $1/N^2$ expansion in some channels with the exchange of definite quantum numbers.

18157 Cut vertices and dimensional renormalization in non-Abelian gauge theories. Gupta, S. (Department of Physics, Columbia University, New York, New York 10027). *Phys. Rev., D;* **21**: No. 4, 984-991(15 Feb 1980).

We use the dimensional-renormalization prescription to define cut vertices in non-Abelian gauge theories. We then show that the cut vertices are well defined in non-Abelian gauge theories by explicitly showing the cancellation of collinear divergences to the lowest nontrivial order in the gluon-gluon vertex.

18158 Phase diagrams for coupled spin-gauge systems. Creutz, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **21**: No. 4, 1006-1012(15 Feb 1980).

Using Monte Carlo techniques, we study Z/sub N/ lattice gauge theory coupled to a Higgs field represented by spins situated on the lattice sites. We present phase diagrams for the Z_2 and Z_6 theories with the Higgs field in the fundamental representation of the gauge group and for Z_6 gauge theory coupled to Z_3 Higgs fields.

18159 Dual variables for lattice gauge theories and the phase structure of Z (N) systems. Ukawa, A.; Windey, P.; Guth, A.H. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08544). EY-76-C02-3072. *Phys. Rev., D;* **21**: No. 4, 1013-1036(15 Feb 1980).

The 't Hooft disorder parameters are constructed within the framework of SU(N) lattice gauge theories in three or four dimensions. It is found that these operators arise naturally from a duality transformation which is similar to the standard transformation for Z (N) gauge theories. To illustrate the behavior of dual variables in a simpler context, we study the Villain form of the Z (N) gauge system in three and four dimensions. The techniques include duality, strong-coupling expansions, and the electrodynamic representation. In four dimensions it is found that for N>N/sub c/ ≅ 4, the system possesses at least three phases: a strong-coupling phase with electric confinement, a weak-coupling phase with magnetic confinement, and an intermediate phase which resembles QED, with a massless photon and no confinement. We also study an SU(N) -Higgs system, which interpolates between the Z (N) and SU(N) systems.

18160 Hadron masses in quantum chromodynamics on the transverse lattice. Bardeen, W.A.; Pearson, R.B.; Rabinovici, E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). W-7405-ENG-48. *Phys. Rev., D;* **21**: No. 4, 1037-1054(15 Feb 1980).

Calculational methods are formulated for the transverse lattice version of quantum chromodynamics. These methods are used to study the low-lying spectrum of gluon bound states in the pure Yang-Mills theory.

18161 Hamiltonian formulation of the SU(2) gauge field in interaction with an external source. Kiskis, J. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **21**: No. 4, 1074-1079(15 Feb 1980).

When the gauge field interacts with an external source, the Gauss-law constraints are second class. The difficulties associated with this are resolved by a canonical transformation. A positive Hamiltonian expressed in terms of unconstrained canonical variables is obtained.

18162 Systematic investigation of effects of heavy particles via factorized local operators and the renormalization group. II. Explicit calculations in quantum electrodynamics. Kazama, Y.; Yao, Y. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Phys. Rev., D;* **21**: No. 4, 1138-1150(15 Feb 1980).

We continue our systematic investigation of effects of heavy particles in low-energy physics initiated in the preceding paper. It was shown therein that in renormalizable theories without spontaneous symmetry breaking, where there are heavy (M) and light (m) particles, all the O ($1/M^2$) heavy-particle effects in any proper amputated light Green's function can be written in a factorized form Γ (M,m)/sub fulltheory/=Γ (m)/sub lighttheory/ +($1/M^2$) Σ/sub N/C/sub N/(M,m) Γ (O/sub N/;m)/sub lighttheory/. The functions C/sub N/(M,m), which are the universal coefficients associated with certain local operators O/sub N/, were shown to satisfy a set of Callan-Symanzik-type equations. In the present article, these equations are explicitly solved in QED with the relevant anomalous dimensions evaluated to one-loop order. As an application within QED, assessment of the effects of muon loops on the electron anomalous magnetic moment is made and absence of leading logarithms in this quantity to all orders in the coupling constant e is proved.

18163 Justification of the Okuba-Zwang-Iizuka rule in quantum chromodynamics. Muzinich, I.J.; Paige, F.E. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev., D;* **21**: No. 4, 1151-1167(15 Feb 1980).

We present an analysis of the theoretical issues involved in justifying the Ohuka-Zwang-Iczuka rule in quantum chromodynamics. We consider as a model a S-wave bound state of a quark-antiquark pair so heave that the binding can be taken to be approximately coulombic. We know from general arguments based on the Kinoshita-Lee-Nauenberg theorems that there is no sensitivity to an infrared cutoff in physical decay rates. Therefore, it is sufficient to analyze the sources of soft gluons with energies ranging down to the binding energy or inverse size of the system. We show that the amplitudes for such soft gluons are suppressed, appearing only as relativistic or binding-energy corrections. Thus, these processes are smaller than their naive level obtained by counting orders of perturbation theory. The leading infrared-sensitive corrections, which are of order α/sub s/ ^{2}lnα/sub s/, arise from relativistic corrections to gluon exchange between the quark-antiquark pair, similar to those in positronium. In our analysis we find a breakdown of perturbation theory from multiple Coulomb-gluon exchange following the emission of a soft gluon from a binding gluon. This can be resolved by summing a class of graphs as in the corresponding analysis of the static potential and the non-Abelian multipole expansion.

PHYSICS RESEARCH

NUCLEAR PHYSICS

18164 (JINR-D—3-11787, pp 247-279) **Neutron physics at LASL.** Keyworth, G.A. (Los Alamos Scientific Lab., NM (USA)). 1978.

From 3. international school on neutron physics; Alushta, USSR (19 Apr 1978).

An overview of the total program at LASL (Los Alamos Scientific Laboratory, USA), describing the scope of experimental capabilities and major research interests, but with particular emphasis on the emerging research program at the new Los Alamos Meson Physics Facility (LAMPF) is attempted. The LAMPF time-of-flight facility utilizes the 800 MeV proton beam from LAMPF in conjunction with a high-Z target as a spallation source of pulsed neutrons (500 μs pulse duration). The proton storage ring design and operating modes are described. The experimental neutron physics programs currently under way at the LAMPF time-of-flight facility, in

the Tandem Van de Graaf Laboratory, on the Omega West reactor and using underground nuclear explosions are elucidated. Their scope ranges from high-resolution fission cross section measurements at LAMPF, fusion reactor physics studies at the Van de Graaf, material researches at the Omega to the taking of equation-of-state data at high pressures using nuclear explosives.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

18165 **Pion charge exchange on tritium.** Glodis, P.; Braendle, H.; Haddock, R.; Kostoulas, I.; Matz, N.; Nefkens, B.; Plumlee, W.; Sander, O.; Pratt, J.; Sherman, R.; Shively, F.; Spencer, J. (University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **44**: No. 4, 234-237(28 Jan 1980).

Measurements of the differential cross section for pion charge exchange on ^{3}H have been carried out at incident pion momenta of 232 and 252 MeV/c. The results are compared with several theoretical predictions and also with charge-independence bounds determined from elastic-scattering cross sections obtained in the same experiment.

18166 **Photodisintegration of ^{3}H.** Faul, D.D.; Berman, B.L.; Meyer, P.; Olson, D.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *Phys. Rev. Lett.;* **44**: No. 3, 129-132(21 Jan 1980).

Measurements of the two-body and three-body photodisintegration cross sections for tritium are reported. The measurements were done with monoenergetic photons, high-pressure gas samples, and neutron-multiplicity detection. Presently available theoretical calculations are not adequate to explain the results.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

18167 **Narrow Σ-hypernuclear states.** Gal, A.; Dover, C.B. (The Racah Institute of Physics, The Hebrew University, Jerusalem, Israel). EY-76-C-02-0016. *Phys. Rev. Lett.;* **44**: No. 6, 379-382(11 Feb 1980).

It is shown that the spin-isospin dependence of low-energy $\Sigma N \rightarrow \Lambda N$ conversion leads to substantial quenching of nuclear-matter estimates of the widths of some Σ-hypernuclear states produced in (K^{-},π) reactions, to a level below 10 MeV. The estimated widths compare favorably with those of the Σ-hypernuclear peaks recently observed at CERN for ^{7}Li, ^{9}Be, and ^{12}C. Tentative quantum number assignments are suggested for these states.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 18167

18168 (LA—8166-T) **Large momentum transfer neutron pickup with the (π^{+},p) and (p,d) reactions.** Smith, G.R. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 393p. Dep. NTIS, PC A17/MF A01.

The (p,d) reaction was studied for the first time at 800 MeV on seven targets ranging from ^{7}Li to ^{40}Ca. The experimental resolution (~ 400 keV) attained was sufficient to observe many discrete levels in each of the residual nuclei. A modified version of the one-nucleon model successfully describes the magnitude and angular dependence of almost all of the transitions observed. A specific counter example to the two-nucleon model of the reaction mechanism is suggested. The calculations are also sensitive to the neutron single-particle wave function, in accordance with the expectation that the high-momentum components of this wave function are probed at higher bombarding energies. States that have never been seen before were strongly populated in the high excitation region (up to 25 MeV) of some of the residual nuclei. The relative intensities of the other levels observed suggest that coupled-channels mechanisms play an important role for some of these states. Explicit calculations were performed to confirm this for several examples. The first high-resolution measurements of the (π^{+},p) reaction were also performed on ^{6}Li, ^{7}Li, ^{12}C, and ^{13}C at pion bombarding energies on and off the pion-nucleon resonance. Calculations employing a one-nucleon model of the reaction mechanism similar to the model successfully used for the (p,d) reaction are unable to account for transitions in the (π^{+},p) reaction. It is, however, unclear whether this failure is due to a fundamental inadequacy of the model or improper treatment of details in the calculations. A striking similarity was observed in the spectra of the (π^{+},p) and 800-MeV (p,d) reactions on the same target; this result implies a similar mechanism for the two reactions. 120 references, 97 figures, 15 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

REFER ALSO TO CITATION(S) 18168

ENERGY LEVELS AND TRANSITIONS

18169 (ANL—79-40, pp 82-83) **Gamma decay in ^{45}V.** Gronemeyer, S.; Meyer-Schuetzmeister, L.; Hardie, G.; Elwyn, A.J. 1979. In Physics Division annual review, 1 April 1978-31 March 1979.

The ^{40}Ca(^{7}Li,2n)^{45}V reaction was studied by means of prompt and delayed n-γ and γ-γ coincidences. On the basis of the observed gamma cascades, the comparison with those known in the mirror nucleus ^{45}Ti, and lifetime measurements for gamma transitions populating the ^{45}V ground state, preliminary assignments were made for states in ^{45}V. 1 figure. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 18168

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 18170

ENERGY LEVELS AND TRANSITIONS

18170 **Nuclear data sheets for A=63.** Auble, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **28**: No. 4, 559-618(Dec 1979).

Nuclear structure uata on A=63 are compiled and evaluated. Adoped level and decay properties are given. The bulk of the data is presented pictorially for easy comparison. Experimental details, references, and additional comments, where required, are given in the text. All drawings, tables, and comments are reproduced from the Evaluated Nuclear Structure Data File (ENSDF). Any additions or corrections desired by the users should be addressed to the evaluator for maintenance and updating of the data file.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 18178

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 18178

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 18171, 18172

ENERGY LEVELS AND TRANSITIONS

18171 **Nuclear data sheets for A=213.** Ellis, Y.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **28**: No. 4, 619-638(Dec 1979).

The available nuclear structure information for all nuclei with mass number A=213 is presented. Various decay and reaction data are evaluated and compared. Adopted data, levels, and spin and parity assignments are given.

18172 **Nuclear data sheets for A=217.** Ellis, Y.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **28**: No. 4, 639-653(Dec 1979).

The available nuclear structure information for all nuclei with mass number A=217 is presented. Various decay and reaction data are evaluated and compared. Adopted data, levels, and spin and parity assignments are given.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

SPONTANEOUS AND INDUCED FISSION

18173 (DOE/TIC—11144) **Progress report on the 14-MeV fission cross section measurements.** (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). 1979. Contract EY-76-S-04-3347. 17p. Dep. NTIS, PC A02/MF A01.

The development of a recoil proton monitor was completed. It will be used to measure the neutron flux in the 14-MeV fisson cross section measurements. Extensive calculations of the efficiency of this monitor were made and compared with the calculations of other authors. It is clear that a major source of uncertainty in the efficiency is the lack of precise knowledge of the angular distribution of the n-p elastic scattering cross section. This leads to a change in efficiency of 3% depending on the form of the angular distribution that is used. A $4\pi\beta$-γ coincidence system was assembled to investigate the K-correction in determining the absolute activity of foil sources. Iron foils will be used as secondary flux standards in comparing the 14-MeV neutron flux with the fluxes in other laboratories, so this is an important correction to measure. The target and target holders that will be used in the 14-MeV measurements were designed and constructed. Preparations were completed to measure the angular distribution of the fission fragments produced in neutron-induced fission at 14 MeV. 2 figures.

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 18177

18174 **Nuclear structure at high angular momentum.** Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 172-233 of Elementary modes of excitation in nuclei. Bohr, A.; Broglia, R.A. (eds.). Amsterdam, Netherlands; North-Holland (1977).

The author discusses weakly deformed transitional nuclei, the backbending phenomenon and behaviour at very high angular momentum.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 18195

18175 (CONF-800131—5) **Charge exchange probes of nuclear structure and interactions with emphasis on (p,n).** Goodman, C.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From Nuclear structure with intermediate energy probes workshop; Los Alamos, NM, USA (14 Jan 1980).

New results from (p,n) studies at IUCF show that it is possible to observe Gamow-Teller (GT) strength and extract GT matrix elements from (p,n) measurements. The charge exchange reactions (^{6}Li,^{6}He) and (π^+,π^0) involve different projectile quantum numbers, and the relationships of these reactions to (p,n) is discussed.

18176 (JINR-D—3-11787, pp 328-389) **Non-statistical effects in neutron capture.** Mughabghab, S.F. (Brookhaven National Lab., Upton, NY (USA)). 1978.

From 3. international school on neutron physics; Alushta, USSR (19 Apr 1978).

A description is attempted of the present understanding of departures from the extreme statistical model in radiative s- and p-wave neutron capture in the resonance as well as the thermal regions in terms of simple reaction mechanisms. A brief discussion of various capture reaction mechanisms (direct or hard sphere capture, channel capture or valence neutron model, semidirect capture or doorway state formation) is presented. Spin and parity assignments from measurements of γ ray spectra and angular distributions are discussed. The γ ray energy dependence of the partial decay widths provides one with a signature of the type of reaction mechanism.

18177 **Study of giant resonances in nuclei by inelastic scattering.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)). pp 271-351 of Elementary modes of excitation in nuclei. Bohr, A.; Broglia, R.A. (eds.). Amsterdam, Netherlands; North-Holland (1977).

The author reviews the direct experimental evidence for giant resonances, primarily that obtained from the inelastic scattering of electrons, and hadrons and discusses the interpretation of these data. The main emphasis is on the new giant isoscalar quadrupole mode (GQ_0R).

18178 **Effect of Pauli blocking on exchange and dissipation mechanisms operating in heavy-ion reactions.** Schroeder, W.U.; Birkelund, J.R.; Huizenga, J.R.; Wilcke, W.W.; Randrup, J. (Departments of Chemistry and Physics, University of Rochester, Rochester, New York 14627). *Phys. Rev. Lett.;* **44**: No. 5, 308-312(4 Feb 1980).

Systematic properties of dissipation and exchange mechanisms associated with damped nuclear reactions are obtained from available data, yeilding results that cannot be consistently described in a classical approach. However, correlations between energy loss and the variances of the fragment A and Z distributions are understood on the basis of an exchanged-induced dissipation mechanism, if account is taken of the Pauli exclusion principle.

NUCLEAR MODELS

18179 **Unified treatment of the parity violating nuclear force.** Desplanques, B.; Donoghue, J.F.; Holstein, B.R. (Institut de Physique Nucleaire, Division de Physique Theorique, 91406 Orsay Cedex: France). EY-76-C-02-3069. *Ann. Phys. (N.Y.);* **124**: No. 2, 449-495(Feb 1980).

We discuss the weak amplitudes which determine the parity violating nuclear force. By use of the quark model and the SU (6)/ sub w/ symmetry, we unite the treatment of pion and wector meson vertices, and describe the interrelation of past techniques which have been applied to this problem. This allows us to catalog the uncertainties in the amplitudes, and to provide reasonable bounds on their values. The connection of our results with experiments is also discussed.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 17427, 18184, 18239

18180 **PION-1. A Monte Carlo computer program for calculations with negative pion beams.** Wright, H.A.; Hamm, R.N.; Turner, J.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Radiat. Res.;* **79**: No. 1, 1-21(Jul 1979).

An earlier publication described a computer program for calculating depth-dose distributions in water phantons irradiated by positive or negative pion beams. This program, now called PION-I, has been substantially improved and modified as described here with emphasis on applications of negative pions to cancer radiotherapy. Modifications that have been made include a much improved treatment of multiple Coulomb scattering, the addition of range straggling, the addition of elastic scattering of pions from heavy nuclei, a new method of computing the neutron dose distribution around pion stars, provisions for calculating cell survival, and the inclusion of a code for computing isodata contours. Calculations with PION-I can also include the effects of inhomogeneities, such as regions of bone, lung, or air in tissue phantoms. A number of examples are given of the kind of information that can be obtained with PION-I. The relative effects of various physical processes on dose distribution patterns are also assessed.

18181 **Adjoint Monte Carlo electron transport in the continuous-slowing-down approximation.** Halbleib, J.A.; Morel, J.E. (Sandia Laboratories, Albuquerque, New Mexico 87185). AT(29-1)789. *J. Comput. Phys.;* **34**: No. 2, 211-230(Feb 1980).

A model is developed for the Monte Carlo solution of the adjoint transport equation for primary electrons in one dimension. Energy loss is treated in the continuous-slowing-down approximation. The model also employs the condensed-history approximation required in forward Monte Carlo models for transport in extended media. It is tested extensively through numerous calculations of energy deposition and transmission coefficients in aluminum. Predictions are compared with results of the corresponding forward model. Agreement is generally very good. Small discrepancies are attributed to the use of uninterpolated tabular electron cross section data in both forward and adjoint models.

18182 **Radiation transport in earth for neutron and gamma-ray point sources above an air-ground interface.** Lillie, R.A.; Santoro, R.T. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Nucl. Technol.;* **47**: No. 1, 200-207(Jan 1980).

Two-dimensional discrete-ordinates methods have been used to calculate the instantaneous dose rate in silicon and neutron and gamma-ray fluences as a function of depth in earth from point sources at various heights (1.0, 61.3, and 731.5 m) above an air-ground interface. The radiation incident on the earth's surface was transported through an earth-only and an earth-concrete model containing 0.9 m of borated concrete beginning 0.5 m below the earth's surface to obtain fluence distributions to a depth of 3.0 m. The inclusion of borated concrete did not significantly reduce the total instantaneous dose rate in silicon, and in all cases, the secondary gamma-ray fluence and corresponding dose are substantially larger than the primary neutron fluence and corresponding dose for depths > 0.6 m.

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

REFER ALSO TO CITATION(S) 18180

18183 (DOE/NV/00410—55) **CP-50 calibration facility radiological safety assessment document.** Chilton, M.W.; Hill, R.L.; Eubank, B.F. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Mar 1980. Contract AC08-76NV00410. 73p. Dep. NTIS, PC A04/MF A01.

The CP-50 Calibration Facility Radiological Safety Assessment document, prepared at the request of the Nevada Operations Office of the US Department of Energy to satisfy provisions of ERDA Manual Chapter 0531, presents design features, systems controls, and procedures used in the operation of the calibration facility. Site and facility characteristics and routine and non-routine operations, including hypothetical incidents or accidents are discussed and design factors, source control systems, and radiation monitoring considerations are described.

18184 **Determination of absorbed dose in a proton beam for purposes of charged-particle radiation therapy.** Verhey, L.J. (Massachusetts General Hospital, Boston); Koehler, A.M.; McDonald, J.C.; Goitein, M.; Ma, I.C.; Schneider, R.J.; Wagner, M. Contract EY-76-5-02-3522. *Radiat. Res.;* **79**: No. 1, 34-54(Jul 1979).

Four methods are described by which absorbed dose has been measured in a proton beam extracted from the 160-MeV Harvard cyclotron. The standard dosimetry, used to determine doses for patient treatments, is based upon an absolute measurement of particle flux using a Faraday cup. Measurements have also been made using a parallel-plate ionization chamber; a thimble ionization chamber carying a ^{60}Co calibration traceable to NBS; and a tissue-equivalent calorimeter. The calorimeter, which provides an independent check of the dosimetry, agreed with the standard dosimetry at five widely different depths within a range from 0.8 to 2.6%.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 17487, 17507

18185 (LBL—10005) **Kinetics of clustering reactions.** Pundarika, E.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 115p. Dep. NTIS, PC A06/MF A01.

Thesis.

The dynamics of precipitation and coarsening reactions in a binary Ising lattice are studied using a simulation technique. The initial random configuration represents equilibration at a very high temperature. Following a quench to the reaction temperature below the miscibility gap, the decomposition proceeds by atomic interchanges of matrix and impurity atoms. The probability of such interchanges depends on the reaction temperature as also the local environ of the particular atom pair that is interchanging. Both the excess energy <reverse arrow - reverse arrow/sub ∞/> and the average cluster size <n> are found to follow simple power law relations with time, <reverse arrow - reverse arrow/sub ∞/> = t/sup-b/ and <n> = t/sup a/. For the square lattice, Binder's cluster diffusion and coagulation mechanism is seen to dominate the coarsening reactions at early times, in agreement with the studies of Lebowitz et al. The early time exponent (a) correspondingly has a value close to 0.2. However, at later times, the mechanism changes over to a Loofshitz and Slozov atom by atom transfer mechanism, as the cluster size becomes larger. The nature of this changeover is seen to depend primarily on the temperature; the two regions overlap at higher temperatures and are separated by a long incubation period at lower temperatures. The different regions are closely associated with the relative bond type populations which reach asymptotic values as Lifshitz-Slozov coarsening stage begins.

18186 **Renormalization-group studies of antiferromagnetic chains. I. Nearest-neighbor interactions.** Rabin, J.M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev., B: Condens. Matter;* **21**: No. 5, 2027-2037(1 Mar 1980).

The real-space renormalization-group method introduced by workers at the Stanford Linear Accelerator Center (SLAC) is used to study one-dimensional antiferromagnetic chains at zero temperature. Calculations using three-site blocks (for the Heisenberg-Ising model) and two-site blocks (for the isotropic Heisenberg model) are compared with exact results. In connection with the two-site calculation a duality transformation is introduced under which the isotropic Heisenberg model is self-dual. Such duality transformations can be defined for models other than those considered here, and may be useful in various block-spin calculations.

18187 **Finite-size rounding of a first-order phase transition.** Imry, Y. (Department of Physics and Astronomy, Tel Aviv University, Ramat Aviv, Israel). *Phys. Rev., B: Condens. Matter;* **21**: No. 5, 2042-2043(1 Mar 1980).

The finite-size broadening of a first-order phase transition is estimated to be proportional to the inverse of the product of the system size and the latent entropy of the transition. The relation to the usual second-order-transition case is discussed. The limit of a small first-order transition is shown to be consistent with a second-order one. These results are relevant both for real and computer experiments on systems that are quite small but larger than microscopic sizes.

18188 **Possible role of incipient Anderson localization in the resistivities of highly disordered metals.** Imry, Y. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). EY-76-C-02-0016. *Phys. Rev. Lett.;* **44**: No. 7, 469-471(18 Feb 1980).

The scaling theory of Anderson localization by Abrahams et al. is used for dirty conductors jsut above the Anderson transition. When the inelastic mean free path, l/sub ph/, is smaller than the coherence length, ξ, in the extended phase, the conductivity increases with temperature like k/sub ph/ $^{-1}$. This may be related to the quite general correlation between large resistances and their negative temperature derivatives found by Mooij. l/sub ph/>ξ is required to distinguish between the extended and localized regimes.

18189 **Random walks on finite lattices with traps.** Hatlee, M.D.; Kozak, J.J. (Department of Chemistry and Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1400-1407(15 Feb 1980).

We consider dissipative processes involving both chemical reaction and physical diffusion in systems for which the influence of boundaries and system size on the dynamics cannot be neglected. We report the results of Monte Carlo simulations on an irreversible reaction in a confined system subject to two sorts of finite boundary conditions. The problem is posed in such a way as to take maximal advantage of two earlier studies: Montroll's work on random walks on d-dimensional periodic lattices with traps, and the work of Sanders, Ruijgrok, and ten Bosch on random walks on two-dimensional finite lattices with traps. Our results are used to discuss the concept of reduction of dimensionality as introduced by Adam and Delbrueck in their study of biological diffusion processes.

18190 **Wave-packet motion.** Sacks, R.A.; Robinson, J.E. (Science Applications, Schaumberg, Illinois 60195). W-31-109-ENG-38. *Phys. Rev., B: Condens. Matter;* **21**: No. 4, 1449-1456(15 Feb 1980).

The time-dependent Schroedinger equation is integrated numerically to obtain the time evolution of an initially Gaussian packet in the presence of Eckart, truncated quadratic, and untruncated quadratic potentials. Potential and packet parameters are chosen with hydrogen interstitials in transition metals in mind and are varied over significant ranges. Use of the smooth, bounded Eckart potential eliminates the pronounced structure and the anomalous spreading reported previously for other potentials. An interesting transient feature of the scattered packet is found and discussed in terms of the Wigner time delay. Packet transmission coefficients are discussed, and a quasiclassical approximation is found to agree closely with the exact results.

18191 **Inelastic scattering of electrons from adsorbate vibrations: Large-angle deflections.** Tong, S.Y.; Li, C.H.; Mills, D.L. (Department of Physics and Surface Studies Laboratory, University of Wisconsin, Milwaukee, Wisconsin 53201). 144-N346;DOE AT03-79ER10432. *Phys. Rev. Lett.;* **44**: No. 6, 407-410(11 Feb 1980).

Calculations of the energy and angle variation of large-angle, inelastic, electron scattering produced by vibrations in a c (2 x 2) overlayer of CO on Ni(100) are presented. The results show pronounced structure related to the bonding site and symmetry associated with the adsorbed CO molecule. Limitations of the elementary form of the dipole-scattering formula applicable to the regime of small-angle scattering are also discussed.

SUPERCONDUCTIVITY

REFER ALSO TO CITATION(S) 17895

18192 **Pinning effects in periodic superconducting structures.** Martinoli, P.; Clem, J.R. (Institut de Physique, Universite de Neuchatel, CH-2000 Neuchatel, Switzerland). *AIP Conf. Proc.;* **58**: No. 1, 176-185(15 Dec 1979). (CONF-791151—).

From Inhomogeneous superconductors conference; Berkeley Springs, WV, USA (1 Nov 1979).

Pinning effects in superconducting films with periodically varying thickness in one dimension are reviewed. Peak structures in the critical current vs magnetic field curves and Josephson-like quantum phenomena in the flux-flow regime are described with

models based on the interaction of the vortex lattice with the periodic potential created by the thickness modulation.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 17850, 17854, 17862, 17863, 17864, 17882, 17883, 17941

18193 Lower critical field of an anisotropic type-II superconductor. Klemm, R.A.; Clem, J.R. (Department of Physics, University of British Columbia, Vancouver, British Columbia V6T 1W5, Canada). *Phys. Rev., B: Condens. Matter;* **21**: No. 5, 1868-1875(1 Mar 1980).

We consider the Ginzburg-Landau free energy of the anisotropic mass form in the presence of a magnetic field of arbitrary fixed direction. It is shown that the free energy may be transformed into the isotropic Ginsburg-Landau form with a κ that depends upon the direction of the magnetic induction B relative to the crystal lattice. The lower critical field H/sub c/1 is then found for arbitrary direction of B. For highly anisotropic crystals the angular dependence of H/sub c/1 can exhibit a discontinuity or a cusp. The special case of a crystal with uniaxial symmetry is considered in detail.

18194 Steady-state flux-line cutting in type II superconductors. Clen, J.R. (Ames Laboratory: USDOE and Department of Physics, Iowa State University, Ames, Iowa). W-7405-ENG-82. *J. Low Temp. Phys.;* **38**: No. 3, 353-370(1 Feb 1980).

Flux-line cutting (intersection and cross-joining of adjacent nonparallel vortices) has been suggested as a mechanism for steady-state dissipation in current-carrying, type II superconductors in longitudinal magnetic fields. In this paper a specific theoretical flux-line-cutting model is proposed which generates a constant steady-state electric field in a current-carrying, ideal, type II superconducting slab in a longitudinal field. The assumed model consists of parallel vortex planes at different angles which periodically shuttle back and forth between the regions in which flux-line cutting occurs. The resulting macroscopic electric current and magnetic flux density distributions are calculated. The model yields a nonlinear voltage—current characteristic and a longitudinal paramagnetic moment.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 18190

18195 (LBL—10321) **Role of fluctuations in the quantal description of damped motion.** Hernandez, E.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

The construction of a frictional time-dependent Schroedinger equation is reviewed for harmonic motion in a restricted framework, i.e., demanding the conservation of the Gaussian shape of wave packets. The evolution of the quanta fluctuations is discussed in a time-independent model, and it is shown that such a situation does not correspond to damped harmonic oscillations. The role of fluctuations in providing dissipative behavior is discussed and the time evolution of arbitrary wave functions subject to damped motion as described by Schroedinger-Kostin equation is analyzed in detail.

18196 Quantum inverse method for two-dimensional ice and ferroelectric lattice models. Thacker, H.B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *J. Math. Phys. (N.Y.);* **21**: No. 5, 1115-1117(May 1980).

The quantum inverse scattering transform method previously developed for continuum field theories is applied to the exactly soluble symmetric six-vertex (ice or ferroelectric) lattice model. Operators analogous to those which appear in the quantum inverse treatment of the nonlinear Schroedinger and sine—Gordon equations are constructed on the lattice by forming strings of vertices contracted over horizontal arrows. From the commutation relations for these operators, exact formulas for the eigenstates and eigenvalues of the transfer matrix are obtained without making an explicit ansatz for the wave functions. These results illustrate the connection between the quantum inverse method and the transfer matrix formalism for lattice models.

18197 Particle statistics from induced representations of a local current group. Goldin, G.A.; Menikoff, R.; Sharp, D.H. (Department of Mathematical Sciences, Northern Illinois University, DeKalb, Illinois 60115 and Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Math. Phys. (N.Y.);* **21**: No. 4, 650-664(Apr 1980).

Representations of the nonrelativistic current group SXK are studied in the Gel'fand—Vilenkin formalism, where S is Schwartz' space of rapidly decreasing functions, and K is a group of diffeomorphisms of R/sup s/. For the case of N identical particles, information about particle statistics is contained in a representation of K/sub F/ (the stability group of a point FϵS') which factors through the permutation group S/sub N/. Starting from a quasi-invariant measure μ concentrated on a K orbit Δ in S', together with a suitable representation of K/sub F/ for F$\epsilon\Delta$, sufficient conditions are developed for inducing a representation of SXK. The Hilbert space for the induced representation consists of square-integrable functions on a covering space of Δ, which transform in accordance with a representation of K/sub F/. The Bose and Fermi N-particle representations (on spaces of symmetric or antisymmetric wave functions) are recovered as induced representations. Under the conditions which are assumed, the following results hold: (1) A representation of SXK determines a well-defined representation of K/sub F/; (2) equivalent representations of SXK determine equivalent representations of K/sub F/; (3) a representation of K/sub F/ induces a representation of SXK; and (4) equivalent representations of K/sub F/ determine equivalent induced representations.

RELATIVITY AND GRAVITATION

18198 Cotangent bundle approach to noninertial frames. DeFacio, B.; Retzloff, D. (Applied Mathematics Group, Ames Laboratory DOE, Iowa State University, Ames, Iowa 50011). W-7405-ENG-82. *J. Math. Phys. (N.Y.);* **21**: No. 4, 751-757(Apr 1980).

The most general possible noninertial acceleration in special relativity is formulated with differential forms in the cotangent bundle. We show that the Lie derivative plays the same role in the cotangent bundle that the covariant derivative plays in the tangent bundle. We also show that a cotangent bundle analog of Fermi—Walker transport can be based upon the, "cotangent-geodesic" equation, L/sub u/ω=0. This gives a generalization of the work by Kiehn on classical Hamiltonian mechanics to special relativity.

OPTICS

18199 Transient analysis of nearly degenerate four-wave mixing. Rigrod, W.W.; Fisher, R.A.; Feldman, B.J. (Los Alamos Scientific Laboratory, University of California, P.O. Box 1663, Los Alamos, New Mexico 87545). *Opt. Lett.;* **5**: No. 3, 105-107(Mar 1980).

Exact solutions for the impulse responses of the phase-conjugate backward wave and of the transmitted forward wave in a nonlinear four-wave mixing medium with a cw undepleted pump are derived from an earlier analysis of active contraflow systems by Bobroff and Haus [J. Appl. Phys. 38, 390 (1967)].

ELECTRICITY AND MAGNETISM

18200 Radiation from a uniformly accelerated charge. Boulware, D.G. (University of Washington, Seattle, Washington 98195). EY-76-C-06-1388. *Ann. Phys. (N.Y.);* **124**: No. 1, 169-188(Jan 1980).

The electromagnetic field associated with a uniformly accelerated charge is studied in some detail. The equivalence principle paradox that the co-accelerating observer measures no radiation while falling observer measures the standard radiation of an accelerated charge is resolved by noting that all the radiation goes into the region of space time in accessible to the co-accelerating observer.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

18201 (DOE/ET/53057—1(Vol.1), pp 274-361) **Assessment of rf plugging in open systems.** Aamodt, R.E. (Science Applications, Inc., La Jolla, CA); Post, R.S. Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

This report comprises a review and evaluation of the present data base for the use of high frequency electromagnetic fields as a means for plugging open system traps. The theory and past and present experiments are separately reviewed, and supportive overlap and weaknesses are identified. The potential for useful applications of rf in the mirror program is presented, and recommendations for future emphasis and key issues to be addressed in order to evaluate this potential are discussed.

18202 Theory of second harmonic electron cyclotron resonance heating of tokamak plasma. Hui, B.; Chu, K.R.; Ott, E.; Antonsen, T. (Plasma Physics Division, Naval Research Laboratory, Washington, D. C. 20375). *Phys. Fluids;* **23**: No. 4, 822-825(Apr 1980).

A theoretical and numerical study of tokamak plasma heating by the second harmonic of the electron cyclotron resonance is

presented. It is found that the extraordinary mode is very efficiently absorbed. In contrast to previous calculations, it is also found that the ordinary mode is well absorbed at oblique incidence to the toroidal magnetic field. This finding indicates the feasibility of heating devices of higher densities than would otherwise be possible.

18203 Simulation of lower-hybrid heating in a nonuniform plasma slab. Decyk, V.K.; Morales, G.J.; Dawson, J.M. (Center for Plasma Physics and Fusion Engineering, University of California, Los Angeles, California 90024). EY-76-CO-03-001. *Phys. Fluids;* **23**: No. 4, 826-833(Apr 1980).

A computer simulation study of the excitation of lower hybrid waves by external sources and the associated plasma heating is presented. A plasma slab with a nonuniform density profile is modeled with a two and one-half dimensional electrostatic particle code. Both a finite-length electrostatic antenna and a single wave exciter are considered. The frequency is chosen so that a wave conversion layer exists in the plasma. It is found that a narrow sheath is formed at the plasma edge and the dominant effect is surface electron heating within that region. Ponderomotive force effects as well as the nonlinear generation of harmonics and subharmonics also occur. A low amplitude lower hybrid wave is observed to be excited by the sources and propatates to the wave conversion layer where it is absorbed.

18204 X-ray yields of plasmas heated by 8-nsec neodymium laser pulses. Glibert, K.M.; Anthes, J.P.; Gusinow, M.A.; Palmer, M.A.; Whitlock, R.R.; Nagel, D.J. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Appl. Phys.;* **51**: No. 3, 1449-1451(Mar 1980).

36 elemental targets, beryllium through uranium, were irradiated with 8-nsec FWHM Nd : glass laser pulses focused to $\sim 4 \times 10^{13}$ W/cm^2. X-ray spectra were recorded with a convex-crystal spectrograph and with a 22-channel PIN-diode spectrometer. Line and continuum spectra indicated temperatures of 36589 eV. Total x-ray irradiances in the energy range 0.7—20 keV showed strong peaking as a function of atomic number with a maximum conversion efficiency of 9.6% relative to the incident laser energy. An indication of enhanced N-shell x-ray emission near U is reported here for the first time.

18205 Formation of a spheromak plasma configuration. Goldenbaum, G.C.; Irby, J.H.; Chong, Y.P.; Hart, G.W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). DE-AC05-77ET-53044. *Phys. Rev. Lett.;* **44**: No. 6, 393-396(11 Feb 1980).

A compact, toroidal configuration of magnetized plasma is produced by a combination of Z- and θ-pinch discharges. A paramagnetic toroidal field is produced by currents circulating in the plasma on closed flux surfaces.

18206 Ordinary-mode fundamental electron-cyclotron resonance absorption and emission in the Princeton Large Torus. Efthimion, P.C.; Arunasalam, V.; Hosea, J.C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Rev. Lett.;* **44**: No. 6, 396-400(11 Feb 1980).

Fundamental electron-cyclotron resonance damping for 4-mm waves with ordinary polarization as well as blackbody emission is measured along the midplane of the plasma in the Princeton Large Torus. Optical depths obtained from the data are in good agreement with those predicted by hot-plasma theory. The use of ordinary-mode fundamental electron-cyclotron resonance heating in existing and future toroidal devices is supported by these results.

18207 Steady-state currents driven by collisionally damped lower-hybrid waves. McWilliams, R.; Valeo, E.J.; Motley, R.W.; Hooke, W.M.; Olson, L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Rev. Lett.;* **44**: No. 4, 245-248(28 Jan 1980).

Low power (<50 W) lower-hybrid waves excited in a linear plasma were observed to drive electron currents (a few milliamperes per watt) in the direction of the wave momentum when the waves were collisionally damped. An approximate solution of an electron kinetic equation with a Lorentz collision operator predicts an electron current in this experimental regime (k/sub parallel/ν/sub t// ω∼ν/ωvery-much-less-than1).

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 18236

18208 Quasiquadrature interferometer for plasma density radial profile measurements: Achieving ten channel operation. Lowenthal, D.D. (Mathematical Sciences Northwest, Inc., P.O. Box 1887, Bellevue, Washington 98009). EY-76-C06-2319. *Rev. Sci. Instrum.;* **51**: No. 4, 440-444(Apr 1980).

A quadrature interferometer designed to measure radial electron density profiles in a long (3 m) small bore (2.8 cm) plasma tube, and described previously in this journal, has been further developed to have ten simultaneously operating channels. Achieving multichannel operation was essential to the accurate measurement of radial electron density profiles and required the design, fabrication, and implementation of two closely matched optical polished quartz tube sections. The first polished cylinder forms the cross tube scene beam window and is used as a sleeve to join ceramic tube sections that comprise the bulk of the 3-m plasma tube. The second matched cylindrical section is placed in the interferometer reference beam to compensate for the strong negative lens affects of the cylindrical scene beam window. Design criteria for the cylindrical tube sections is discussed, the plasma tube assembly technique is given, and typical ten channel data is presented for a laser heated 3-m-long theta-pinch.

18209 Designing a probe beam and an ultraviolet holographic microinterferometer for plasma probing. Pierce, E.L. (Lawrence Livermore Laboratory, P.O. Box 808, University of California, Livermore, California 94550). W-7405-ENG-48. *Appl. Opt.;* **19**: No. 6, 952-961(15 Mar 1980).

The requirements and techniques for time- and space-resolved picosecond probing of laser-produced plasmas are reviewed. The design and limitations of a holographic microinterferometer are discussed, and optical pulse techniques are presented. This technique can provide significant data for understanding the absorption of energy within laser-produced plasmas. The primary requirements are to measure the electron densities in the 10^{20}—10^{21}-e/cc range, with density contour velocities of 10^6 to 10^7 cm/sec and spatial resolution of 1 μm or better. For these velocities one requires a probe pulse duration of 3—30 psec, an UV wavelength as short as feasible, and large numerical aperture optics corrected for spherical aberration. Interferograms of laser-produced plasma obtained at 2660 A with a combined resolution of 1 μm and 15 psec are presented.

PLASMA KINETICS - GENERAL

18210 (DOE/ET/53057—1(Vol.1), pp 193-273) **Trip report for the Department of Energy: sponsored trip to Japan Fusion Laboratories.** Aamodt, R.E. Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

The purpose of this trip to Japan was to evaluate the data base for RF plugging of cusps and mirrors. It appears that (a) RF plugging can enhance containment in such devices; (b) extremely low efficiency of RF power is presently the case, with efforts in the future being directed at improving this by antenna design and frequency selection; and (c) the observed enhanced containment can be explained as primarily due to (ion) heating.

18211 (DOE/ET/53057—1(Vol.2), pp 639-644) **MAK1 benchmarks.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

For the reactor computations of MAK1 to be meaningful, the physical models must do a reasonable job of describing present day experiments. Accordingly we have set the levels of the anomalous transport coefficients to most accurately describe those experiments which involve the least extrapolation to the reactor regime. At the present time, the two most relevant experiments are the Alcator-A and the neutral-beam heated PLT. Alcator-A having the highest-values of n tau and providing data over a wide range of densities allows a good calibration of the empirical electron heat conductivity coefficients while PLT additionally gives maximum levels at which trapped-particle modes may operate consistent with the observed ion temperatures. Graphs of the agreement between MAK1 and the experiments are shown using either an empirical anomalous electron thermal conductivity or the MAK1 phenomenological model. An experimental temperature profile is shown with the corresponding MAK1 profile plotted on it.

18212 (DOE/ET/53057—1(Vol.2), pp 650-651) **Kinematics and control of ETF tokamak reactor.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

Brief discussions of the following topics are given: (1) current rise and preheating; (2) beam heating to ignition; (3) transition to burn; (4) burn; and (5) shutdown. (MOW)

PLASMA KINETICS - EXPERIMENTAL

18213 (DOE/ET/53057—1(Vol.2), pp 482-541) **Structure of impurities in a toroidal discharge.** Byrne, R.N.; Cotsaftis, M. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

A simplified system giving the evolution of the densities of the various ionization levels of a light impurity atom in a tokamak discharge is proposed. This system includes in the expression of the flux for each level a neoclassical and an anomalous part. The

neoclassical part can be shown to take, under some hpothesis, a simple form useful for numerical applications. The anomalous part is mainly induced by the electron anomaly which develops in the course of the discharge, making these anomalies closely linked. This situation, in which there is a restricted number of free adjustable parameters, is called the modified neoclassical regime. The analysis has been applied to a well documented TFR discharge in which the densities of four ionization levels have been simultaneously and independently measured. Good agreement with experimental results is found, thus providing an interesting approach to the study of the electron anomaly itself through its link to the impurities.

18214 (DOE/ET/53C57—1(Vol.2), pp 631-636) **Interpretation of cyclotron radiation spectra from runaway discharges in TFR.** Tamor, S. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

The cyclotron radiation spectra from runaway tokamak discharges are discussed and numerical studies reported which attempt to fit the observed data with simple model distribution functions. A model is exhibited which is both physically reasonable and in qualitative agreement with experiment. A tentative attempt is made to compare this result with the theory for runaway dynamics of Parail and Pogutse. It is found that a consistent picture can be formulated if some assumptions are made concerning initial breakdown conditions.

PLASMA KINETICS - THEORETICAL

18215 (COO—2218-142) **User's guide for FRMOD, a zero dimensional FRM burn code.** Driemeryer, D.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 15 Oct 1979. Contract EY-76-S-02-2218. 17p. Dep. NTIS, PC A02/MF A01.

The zero-dimensional FRM plasma burn code, FRMOD is written in the FORTRAN language and is currently available on the Control Data Corporation (CDC) 7600 computer at the Magnetic Fusion Energy Computer Center (MFECC), sponsored by the US Department of Energy, in Livermore, CA. This guide assumes that the user is familiar with the system architecture and some of the utility programs available on the MFE-7600 machine, since online documentation is available for system routines through the use of the DOCUMENT utility. Users may therefore refer to it for answers to system related questions.

18216 (COO—2218-143) **User's guide for MCFRM, a Monte Carlo particle code for FRM studies.** Driemeyer, D.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 15 Oct 1979. Contract EY-76-S-02-2218. 12p. Dep. NTIS, PC A02/MF A01.

The Monte Carlo particle code MCFRM described in this work is also written in the FORTRAN language and is available on either the MFE-7600 or the CRAY-1 computers. The discussion presented here deals only with the steps required to execute the code on the CRAY, since the majority of its use should be on that machine.

18217 (DOE/ET/53057—1(Vol.1)) **Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.** Aamodt, R.E.; Byrne, R.N.; Catto, P.J. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Dec 1979. Contract EY-76-C-03-1018. 368p. (SAI—023-79-1076-LJ(Vol.1)). Dep. NTIS, PC A16/MF A01.

An abstract was prepared for the progress summary on transport theory for open and closed magnetic configurations. Seven abstracts were prepared for included appendices of more detailed work on individual devices. Also included is a list of publications, technical presentations, and DOE program contributions. (MOW)

18218 (DOE/ET/53057—1(Vol.1), pp 1-28) **Mirror, tokamak, and EBT confinement studies.** Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

This report details work performed by the SAI plasma groups; the laboratory for Applied Plasma Studies and the Plasma Research Institute under contract with the Department of Energy during the period October 1, 1978 through September 30, 1979. The research performed emphasized numerical code development, studies, and analytic modeling of the magnetic containment devices: tokamaks, mirrors, linear solenoids, elmo bumpy tori, and field reversed mirrors, theta pinches, and tori. For toroidal configuratio.ns the majority of the effort was in upgrading one- and two-dimensional modular transport codes. These were improved by developing new and more accurate impurity transport models, incorporating more flexible boundary conditions, developing plateau and banana transport models for EBT, including universal and trapped particle models transport where appropriate, and allowing for low, zero, and reversed toroidal magnetic field 2D transport calculations. Analytically, a kinetic relativistic EBT electron ring structure was derived and studies a variational principle formulated for EBT banana transport, and stability of collisional drift and trapped electron modes reassessed. For open magnetic containment devices the majority of SAI's effort was in analytic studies related to mirror devices.

18219 (DOE/ET/53057—1(Vol.1), pp 29-77) **Neoclassical transport in EBT.** Hazeltine, R.D. (Univ. of Texas, Austin); Krall, N.A.; Klein, H.H.; Catto, P.J. Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

This calculation clarifies the ordering of transport regimes in EBT. It obtains explicit analytic estimates of the transport rates in these regimes, identified as one collisional and two collisionless regimes, plateau and banana.

18220 (DOE/ET/53057—1(Vol.1), pp 79-113) **Collisionless limit of bumpy torus transport.** Catto, P.J.; Rosenbluth, M.N. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

Two transport models are described. The first model is the axisymmetric bumpyless torus which might be valid in the electron ring region if most of the ions are untrapped. Next a bumpy torus model is considered in which Ω is evaluated neglecting toroidal effects and V is obtained by assuming B varies as 1/R due to the toroidal field coils. (MOW)

18221 (DOE/ET/53057—1(Vol.2)) **Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.** Aamodt, R.E.; Byrne, R.N.; Catto, P.J. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). Dec 1979. Contract EY-76-C-03-1018. 343p. Dep. NTIS, PC A15/MF A01.

Separate abstracts were prepared for each of the 20 included appendices. (MOW)

18222 (DOE/ET/53057—1(Vol.2), pp 374-379) **Collisional transport in G2M.** Byrne, R.N. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

The purpose of this note is to set down the Pfirsch-Schlueter and classical transport coefficients used in G2M. The argument used is due to Hazeltine and Hinton (Phys. Fluids, 16:1833(1973)), and the results of course agree with theirs.

18223 (DOE/ET/53057—1(Vol.2), pp 380-381) **Modelling ZT-40 with the G2M diffusion code.** Byrne, R.N. (Science Applications, Inc., La Jolla, CA); Chu, C.K. Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

The G2M tokamak diffusion code has been modified to include the model of anomalous diffusion developed for the ATHENE code to model the slow evolution of reversed field pinches. The resulting code thus includes neutral and impurity transport, impurity radiation, and various anomalous transport models developed for tokamaks.

18224 (DOE/ET/53057—1(Vol.2), pp 382-443) **Transport studies in a neutral beam-heated tokamak (preliminary studies).** Mascheroni, P.L.; Byrne, R.N.; Sulton, A.L. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

A transport code (G2M) with neoclassical and anomalous effects was used to study the transport in tokamaks. The numerical results lead to a reasonable agreement with PLT neutral beam injection-heating experimental data.

18225 (DOE/ET/53057—1(Vol.2), pp 444-457) **Technique for solving the non-linear partial differential equations of tokamak transport.** Klein, H.H.; Byrne, R.N. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

A linearization technique was used to describe a set of equations that modeled tokamak transport. This technique has allowed the equations to be solved using implicit (time) differencing while retaining their conservation properties and subject to the elliptic constraint. (MOW)

18226 (DOE/ET/53057—1(Vol.2), pp 458-480) **Modelling ZT-40 with G2M diffusion code.** Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

One-dimensional equations are given for ion and electron energies, toroidal flux, poloidal flux, pressure balance, and transport. A numerical solution of the inverse Grad-Shafran of equation is given. Some initial profiles for Zeta are also presented. (MOW)

18227 (DOE/ET/53057—1(Vol.2), pp 542-565) **Modeling for diffusion of plasma in field reversed configurations.** Hamasaki, S. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

One-dimensional (1-D) modeling for diffusion of plasma in field reverse configurations like field reversal experiments (FRX) of LASL is summarized here. The 1-D modeling incorporates some interesting 2-D features in field reversed configurations including (i) leakage of particles through open field lines, (ii) density and temperature equalization at the two different radial points which are connected by the magnetic flux lines in the closed field region, and (iii) axial contraction or expansion. Numerical calculations by the G1M/HYBRID code of anomalous diffusion due to the lower hybrid drift and drift ion cyclotron instability have been carried out.

18228 (DOE/ET/53057—1(Vol.2), pp 566-594) **ANTIC: a code for calculation of neutral transport in cylindrical plasmas.** Tamor, S. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

A scheme for computing the steady state transport of neutral atoms in cylindrical plasmas is described. The physical model used represents atoms emerging from charge exchange collisions by an isotropic source of neutrals with energy equal to 3/2 times the local ion temperature. The processes of charge exchange and impact ionization by electrons and ions are included. The transport can be described by an integral equation for the charge exchange collision density, and this equation approximated by a set of algebraic equations for the zone average collision densities. A derivation of the appropriate kernel and a technique for computing it are presented. Comparison of computed results with predictions of other, more exact codes exhibit quite satisfactory agreement for temperature as high as 10 keV.

18229 (DOE/ET/53057—1(Vol.2), pp 595-617) **Transport and radiation studies of belt pinches and high-beta tokamaks.** Byrne, R.N. (Science Applications, Inc., La Jolla, CA); Chu, C.K. Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

Transport and radiation studies are performed for 2:1 ratio elliptical cross-section plasmas using the toroidal geometry diffusion code G2M. The Torus I and II machines at Columbia University are used as models. From the viewpoint of radiation, these machines represent the general classes of cold pinch-tokamaks ($T \sim 10$ eV) and hot pinch-tokamaks ($T \sim 100$ eV), which are qualitatively different because of oxygen impurities. Two types of profiles are studied: parabolic density and temperature distributions, and force-free current profiles, with density peaked near the center and temperature almost flat.

18230 (DOE/ET/53057—1(Vol.2), pp 637-638) **Improvements of MAK1 subsequent to December 1, 1978.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

The MAK1 code has been upgraded in each of the following areas: (1) numerics; (2) pellet refueling module; (3) neutral beam modules; (4) transport modules; and (5) control modules. (MOW)

18231 (DOE/ET/53057—1(Vol.2), pp 645-649) **New routine for neutral injection including ripple effects.** Tamor, S. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

An exact treatment of the problem is a very large undertaking in view of the complicated geometry of the magnetic field and of the trapped part of the phase space, and appears to be possible only with Monte Carlo codes. For purposes of reactor simulation, it is desirable to have a reasonably fast code even at the sacrifice of some detail in the physics. The routine described here was developed to fill this need. The neutral beam is described by up to 5 monoenergetic pencil beams. Their common energy and each current can vary with time. The allowed beam directions are restricted by requiring that if they have a nonvanishing Z (vertical) component they must be coplanar and each point of closest approach to the axis must lie in the plane $Z = 0$. This restriction eliminates the need for solving quartic equations. The magnetic surfaces are assumed to be circular and plasma properties are constant on a magnetic surface.

18232 (ORNL/TM—7219) **Models for impurity effects in tokamaks.** Hogan, J.T. (Oak Ridge National Lab., TN (USA)). Mar 1980. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

Models for impurity effects in tokamaks are described with an emphasis on the relationship between attainment of high β and impurity problems. We briefly describe the status of attempts to employ neutral beam heating to achieve high β in tokamaks and propose a qualitative model for the mechanism by which heavy metal impurities may be produced in the startup phase of the discharge. We then describe paradoxes in impurity diffusion theory and discuss possible resolutions in terms of the effects of large-scale islands and sawtooth oscillations. Finally, we examine the prospects for the Zakharov-Shafranov catastrophe (long time scale disintegration of FCT equilibria) in the context of present and near-term experimental capability.

18233 (PPPL—1568) **Renormalization and plasma physics.** Krommes, J.A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 185p. Dep. NTIS, PC A09/MF A01.

A review is given of modern theories of statistical dynamics as applied to problems in plasma physics. The derivation of consistent renormalized kinetic equations is discussed, first heuristically, later in terms of powerful functional techniques. The equations are illustrated with models of various degrees of idealization, including the exactly soluble stochastic oscillator, a prototype for several important applications. The direct-interaction approximation is described in detail. Applications discussed include test particle diffusion and the justification of quasilinear theory, convective cells, E vector x B vector turbulence, the renormalized dielectric function, phase space granulation, and stochastic magnetic fields.

18234 (PPPL—1641) **Program generator for the Incomplete Cholesky Conjugate Gradient (ICCG) method with a symmetrizing preprocessor.** Kuo-Petravic, G.; Petravic, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1980. Contract EY-76-C-02-3073. 45p. Dep. NTIS, PC A03/MF A01.

This paper is an extension of the previous paper, A Program Generator for the Incomplete LU-Decomposition-Conjugate Gradient (ILUCG) Method which appeared in Computer Physics Communications. In that paper a generator program was presented which produced a code package to solve the system of equations Ax/sub $\sim$/ = b/sub $\sim$/, where A is an arbitrary nonsingular matrix, by the ILUCG method. In the present paper an alternative generator program is offered which produces a code package applicable to the case where A is symmetric and positive definite. The numerical algorithm used is the Incomplete Cholesky Conjugate Gradient (ICCG) method of Meijerink and Van der Vorst, which executes approximately twice as fast per iteration as the ILUCG method. In addition, an optional preprocessor is provided to treat the case of a not diagonally dominant nonsymmetric and nonsingular matrix A by solving the equation A/sup T/Ax/sub $\sim$/ = A/sup T/b/sub $\sim$/.

18235 **Equilibrium and stability of high-β toroidal multipoles.** D'Ippolito, D.A.; Adler, E.A.; Lee, Y.C. (Department of Physics, University of California, Los Angeles, California 90024). EY-76-C-0010;EY-76-C-030010PA26. *Phys. Fluids;* **23**: No. 4, 794-802(Apr 1980).

The equilibrium and stability of finite-β toroidal plasmas confined by multipole fields (with no toroidal component) is studied within the framework of ideal magnetohydrodynamics. Equilibria are obtained by the numerical solution of the Grad—Shafranov equation, including the effect of rigid current-carrying rings within the plasma. Stability to pressure-driven modes (interchange and ballooning) is examined for these equilibria using standard methods. The spatial variation of the critical pressure gradient and the nature of the marginally stable eigenfunctions are discussed. Results are presented for three configurations (quadrupole, octopole, and dodecapole) with parameters similar to those for the Surmac experiment.

18236 **Electric sheath and presheath in a collisionless, finite ion temperature plasma.** Emmert, G.A.; Wieland, R.M.; Mense, A.T.; Davidson, J.N. (University of Wisconsin, Madison, Wisconsin, 53706). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 4, 803-812(Apr 1980).

The plasma-sheath equation for a collisionless plasma with arbitrary ion temperature in plane geometry is formulated. Outside the sheath, this equation is approximated by the plasma equation, for which an analytic solution for the electrostatic potential is obtained. In addition, the ion distribution function, the wall potential, and the ion energy and particle flux into the sheath are explicitly calculated. The plasma-sheath equation is also solved numerically with no approximation of the Debye length. The numerical results compare well with the analytical results when the Debye length is small.

18237 **Strong plasma turbulence and anomalous diffusion in a magnetic field.** Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 3, 498-507(Mar 1980).

Plasma diffusion in the presence of strong turbulence has been studied by means of analytic theory and numerical simulations. First, diffusion and turbulent fluctuation spectra in the presence of convective cells are studied using a two-dimensional guiding center model and a two-fluid model retaining ion inertia. It is shown that for these models, turbulent diffusion takes place which dissipates a density gradient and is associated with the inverse cascades of the fluctuations transferring the electric field energy toward the long wavelength modes. Second, particle diffusion associated with drift wave turbulence using full dynamic ions and Debye shielding electrons is

considered. It is shown that diffusion and the inverse cascades are much slower in this model compared with those found for convective cell turbulence. This difference arises from the fact that the mode coupling coefficient for inverse cascade is much smaller for the drift wave turbulence compared with the turbulence associated with the convective cells.

18238 Rotation of a classical toroidal plasma. Wen, S.; Pao, Y. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). EY-76-C-02-3077. *Phys. Fluids;* **23**: No. 3, 636-643(Mar 1980).

The toroidal and poloidal velocity components of an axisymmetric toroidal plasma are calculated using the classical formulae of stress tensors in the magnetohydrodynamic equations. Explicit formulae are obtained and a criterion regarding whether the toroidal velocity component is exponentially increasing or decaying is established. The special case of a large aspect-ratio plasma is also examined.

18239 SPUDNUT: A transport code for neutral atoms in plasmas. Audenaerde, K.; Emmert, G.A.; Gordiner, M. (Department of Nuclear Engineering, University of Wisconsin, Madison, Wisconsin 53706). *J. Comput. Phys.;* **34**: No. 2, 268-284(Feb 1980).

The problem of neutral atom transport in plasmas is formulated in terms of an integral equation for the charge exchange collision density. This formulation is used as the basis for a numerical code, SPUDNUT, which is exceptionally fast and compact. Comparative calculations with other neutral particle transport codes are presented.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 18227, 18235, 18262

18240 (DOE/ET/53057—1(Vol.1), pp 117-146) **Axis encircling ion gyro-instability.** Catto, P.J. (Science Applications, Inc., Boulder, CO); Aamodt, R.E.; Rosenbluth, M.; Byers, J.A.; Pearlstein, L.D. Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

An idealized plasma model in which all the ion guiding centers lie along the magnetic axis of a cylindrically symmetric plasma is investigated. The radial eigenvalue equation is derived and solved for this strongly unstable limit.

18241 (DOE/ET/53057—1(Vol.1), pp 148-189) **Nonlocal hybrid-kinetic stability analysis of the mirror drift-cone instability.** Davidson, R.C. (Massachusetts Inst. of Tech., Cambridge); Uhm, H.S.; Aamodt, R.E. Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

A hybrid-kinetic model (Vlasov ions and cold-fluid electrons) is used to develop a fully nonlocal theory of the mirror-drift-cone instability. The stability analysis assumes electrostatic flute perturbations about a cylindrical ion equilibrium f/sub i/^{0}(H/sub perpendicular to/ - ω/sub i/P/sub theta/, v/sub z/), where ω/sub i/ = const. = angular velocity of mean rotation. The radial eigenvalue equation for the potentail amplitude phi(r) is solved exactly for the particular choice of f/sub i/^{0} corresponding to a sharp-boundary (rectangular) density profile. The resulting dispersion relation for the complex eigenfrequency ω is investigated numerically for a broad range of system parameters including the important influence of large ion orbits and ion thermal effects.

18242 (DOE/ET/53057—1(Vol.2), pp 362-366) **Resistive drift-Alfven waves in sheared magnetic fields.** Catto, P.J. (Science Applications, Inc., Boulder, CO); Tsang, K.T. Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

A new class of resistive drift-Alfven modes is discovered. The new modes are believed to be the generalization of shear-Alfven waves to sheared magnetic fields. In addition, the finite β (plasma over magnetic pressure) corrections to the electrostatic dissipative drift wave are evaluated.

18243 (DOE/ET/53057—1(Vol.2), pp 367-372) **Analytic eigenvalue equations for collisionless drift waves in tokamaks.** Catto, P.J. (Science Applications, Inc., Boulder, CO); Tsang, K.T. Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

Recently, collisionless drift waves in sheared magnetic fields were shown to be stable. The validity of the analytic model employed in one of these investigations is examined in detail.

18244 (DOE/ET/53057—1(Vol.2), pp 618-630) **Persistence of MHD stability in field reversed pinches against microinstabilities.** Hamasaki, S. (Science Applications, Inc., La Jolla, CA); Krall, N.A.; McBride, J.B. Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

This paper addresses the question of persistence of MHD stable profiles in reversed field Z-pinches considering the possibility of enhanced transport due to various microinstabilities. We find that Suydam's criterion for MHD stability usually requires sufficient magnetic shear to prevent microinstabilities throughout most of the radial profiles.

18245 (NRL-MR—4173) **Steady state magnetic diffusion from resistive interchange modes.** Manheimer, W.M. (Naval Research Lab., Washington, DC (USA)). 5 Mar 1980. Contract EX-76-A-34-1006. 9p. Dep. NTIS, PC A02/MF A01.

It is shown that a likely nonlinear state for resistive interchange modes is one in which velocity vortex structure is balanced in Ohmic dissipation. Macroscopically this is manifested as magnetic diffusion and anomalous energy transport. The results are discussed and compared with recent experiments.

18246 Critical lengths for high density mirror machines. Gerver, M.J. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). EY-76-S-02-3170. *Phys. Fluids;* **23**: No. 4, 755-763(Apr 1980).

Critical lengths are found for the stability of mirror-confined plasmas to the convective loss-cone mode (driven absolutely unstable by wave reflection from the mirror throats), using the straight-line ion orbit approximation. Electromagnetic effects are included. For fusion reactor parameters, the critical length in ion Larmor radii is roughly 10β/sup -1/2/ (where β is the ratio of plasma pressure to magnetic pressure). Taking the drift cone instability into account, no mirror fusion plasma can be linearly stable unless there is some warm plasma (about 1%) in the loss cone.

18247 Axis encircling iongyro instability. Catto, P.J.; Aamodt, R.E.; Rosenbluth, M.N.; Byers, J.A.; Pearlstein, L.D. (Science Applications, Inc., Laboratory for Applied Plasma Studies, Boulder, Colorado 80302). EY-76-03-1018;W-7405-ENG-48. *Phys. Fluids;* **23**: No. 4, 764-770(Apr 1980).

An idealized plasma model in which all the ion guiding centers lie along the magnetic axis of a cylindrically symmetric plasma is investigated. The radial eigenvalue equation is derived and solved for this strongly unstable limit. Many of the physical features predicted by simple analytic limits of the WKB phase integral condition are verified by a comparison with the results of a particle simulation.

18248 Linear stability of high-m drift-tearing modes. D'Ippolito, D.A.; Lee, Y.C.; Drake, J.F. (Department of Physics, University of California, Los Angeles, California 90024). EY-76-03-0010 PA261TASK I; DE-AC05-77ET 53044. *Phys. Fluids;* **23**: No. 4, 771-782(Apr 1980).

A new model for the electron parallel conductivity in a plasma of moderate collisionality is formulated using the Williamson collision operator. With this model, the linear stability of high-m drift-tearing modes (driven unstable by delT/sub e/) is studied as a function of the electron-ion collision frequency ν/sub c/ with no restriction placed on the ratio ν/sub c//ω. It is shown that the growth rate of this instability can be substantial for realistic tokamak parameters. The implication for understanding the observed magnetic turbulence and anomalous electron heat transport in tokamaks is discussed.

18249 Accurate approximation of the dispersion differential equation of ideal magnetohydrodynamics: The diffuse linear pinch. Barnes, D.C.; Cayton, T.E. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Fluids;* **23**: No. 4, 783-790(Apr 1980).

The ideal magnetohydrodynamic stability of the diffuse linear pinch is studied in the special case when the poloidal magnetic field component is small compared with the axial field component. A two-term approximation for growth rates is derived by straightforward asymptotic expansion in terms of a small parameter that is proportional to (B/sub theta//rB/sub z/). Evaluation of the second term in the expansion requires only a trivial amount of additional computation after the leading-order eigenvalue and eigenfunction are determined. For small, but finite, values of the expansion parameter the second term is found to be non-negligible compared with the leading term. The approximate solution is compared with exact solutions and the range of validity of the approximation is investigated. Implications of these results to a wide class of problems involving weakly unstable near θ-pinch configurations are discussed.

18250 Magnetohydrodynamical interchange instability in low-β plasmas in sheared systems. Yoshikawa, S.; White, R.B. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 4, 791-793(Apr 1980).

The stability criterion of a magnetized plasma with respect to interchange in a sheared configuration was reexamined. By retaining the finite growth rate, the singularity at the magnetic surface, where the perturbation is constant along the magnetic line, is removed. The resultant wave equation yields the result that the Suydam condition is both a necessary and a sufficient condition for stability at least for the plasma pressure less than (1-Δ) β/sub c/. Here, β/sub c/ is the maximum β for the original Suydam criterion and Δ is a small positive number (less than 0.03), which presumably can be made arbitrarily small by improving the numerical approximation.

18251 Reply to the comments by K. Itoh and S. Inoue. Catto, P.J.; Rosenbluth, M.N.; Tsang, K.T. (Science Applications, Inc., Laboratory for Applied Plasma Studies, Boulder, Colorado 80302). *Phys. Fluids;* **23**: No. 4, 848(Apr 1980).

The assertion by Itoh et al. of the stability of the collisional shear Alfven wave, based on a quadratic form derived by them, is accepted. The difficulties involved are claimed to result, not from an incorrect expansion, but from difficulties in matching of inner and outer solutions. (AIP)

18252 Convective amplification of universal drift modes. Hinton, F.L.; Rosenbluth, M.N. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). EY-76-C-05-4478. *Phys. Fluids;* **23**: No. 3, 528-536(Mar 1980).

An analytical solution of the wave equation for universal drift modes is derived. More exact analytical expressions for the dispersion relation and the damping rate are obtained than have been obtained previously. The spatial amplification of an incident wave is derived from the solution of the scattering problem. The dependence of the convective amplification factor on the shear is then determined.

18253 Lower-hybrid-drift instability in field reversed plasmas. Huba, J.D.; Drake, J.F.; Gladd, N.T. (Science Applications, Inc., McLean, Virginia 22102). *Phys. Fluids;* **23**: No. 3, 552-561(Mar 1980).

The nonlocal structure of the lower-hybrid-drift instability is investigated in a reversed field configuration. The calculation includes electromagnetic effects and delB electron orbit modifications, which must be considered in the high β region of the current sheet. The eigenmodes are trapped in a potential well centered symmetrically on either side of the neutral layer at vertical-barxvertical-bar~λ (λ is the scale length of the current sheet). The fundamental mode is well localized away from the neutral line with a half-width Δx~ (λ/k/sub y/)/sup 1/2/ << λ, where k/sub y/~Ω/sub e/(T/sub i/m/sub e/)/sup 1/2/ for the fastest growing mode. Higher order modes, however, have growth rates comparable to the fundamental mode and are much more global. In the cold electron limit (T/sub e/=0), the higher order modes with partial/partialx~k/sub y/ can propagate throughout the entire sheet. In the warm electron limit (T/sub e/not =0), the electron delB drift-wave resonance damps the mode and prevents the penetration of the mode closer than vertical-barxvertical-bar/sub p/~λ (T/sub e//2T/sub i/) /sup 1/2/ of the neutral line. The effects of this instability on magnetic energy dissipation and its role in the Los Alamos field reversed theta pinch are discussed.

18254 Stabilization of the Alfven-ion cyclotron instability in inhomogeneous media. Tajima, T.; Mima, K. (Department of Physics, University of California, Los Angeles, California 90024). EY-76-03-0010 PA 26 TASK III. *Phys. Fluids;* **23**: No. 3, 577-589(Mar 1980).

Stabilization criteria for the Alfven-ion cyclotron instability due to anisotropic temperature in inhomogeneous high β plasmas are obtained. A wave equation is derived appropriate to describe the essential aspects of this fluid-type instability in inhomogeneous media. The dispersion relation is obtained with the help of the associated Legendre functions. The critical β for stabilization is a sharply increasing function of the inhomogeneity strength of the system: the critical system length L/sub c/ is approximately proportional to β/sup -1/2/. Under the equilibrium configuration the stability criteria for the mirror mode instability and the present mode are compared, and it is found that those for the mirror mode are more stringent for moderate to large β.

18255 Effects of ion dynamics on tearing modes. Lee, X.S.; Mahajan, S.M.; Hazeltine, R.D. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). DE-AC05-79ET53036. *Phys. Fluids;* **23**: No. 3, 599-604(Mar 1980).

The eigenmode equations of several tearing modes are modified to include the ion dynamic terms, which are derived from a simple self-consistent ion kinetic theory. The stabilizing tendency of the ion acoustic term, noted previously by Bussac and co-workers, is confirmed, and the effect of an additional ion-electron friction term on the dispersion relation is discussed. Quantitative expressions for the change in mode frequency are given.

18256 Coupling of drift modes in a torus. Waltz, R.E.; Pfeiffer, W.; Dominguez, R.R. (General Atomic Company, San Diego, California 92138). EY-76-C-03-0167, PROJECT AGREEMENT NO. 38. *Phys. Fluids;* **23**: No. 3, 605-610(Mar 1980).

The coupling of electrostatic drift modes due to the ion, magnetic curvature drift in a torus is examined analytically and numerically. It is found that this toroidal effect is not sufficient to destabilize the electron drift modes for values of shear, temperature gradients, and current drive that are typical of tokamaks and within the limits of the theoretical approximations.

18257 Interchange stability of axisymmetric field reversed equilibria. Sparks, L.; Finn, J.M.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). EY-76-S-02-3170. *Phys. Fluids;* **23**: No. 3, 611-613(Mar 1980).

Axisymmetric field reversed equilibria are obtained by solving the Grad—Shafranov equation, with pressure on the magnetic axis and pressure on the separatrix specified as independent parameters. A stability criterion assuming unfavorable curvature is evaluated for various pressure profiles.

18258 Ideal magnetohydrodynamic stability of tokamak plasmas. Copenhaver, C. (University of Tennessee, Knoxville, Tennessee 37916). AT-(40-1)-2598. *Phys. Fluids;* **23**: No. 3, 624-635(Mar 1980).

Variational theory is used to derive a generalized Euler equation and a new energy functional which are convenient for analytical studies of ideal magnetohydrodynamic stability in tokamaks. This generalized Euler equation, which is an explicit function of the magnetic surface coordinate psi only, represents an infinite set of equations coupled together by poloidal m mode coupling. In the infinite aspect ratio limit, the toroidal curvature and mode coupling terms disappear and an infinite set of uncoupled Euler equations for the diffuse linear pinch (Hain—Luest equation) for each m value results. The continuous spectra are discussed for the circular toroidal case. In this case, the equations are further specialized to three modes (m, m-1, m+1) and in the marginal stability limit reduce to known results. Analytically eliminating the m-1 and m+1 modes for arbitrary current profiles provides results on limiting β poloidal for tokamaks.

18259 Bifurcations and strange behavior in instability saturation by nonlinear mode coupling. Wersinger, J.; Finn, J.M.; Ott, E. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.;* **44**: No. 7, 453-456(18 Feb 1980).

A simple model for the nonlinear saturation of an instability is studied via numerical solution of the resonant three-wave coupling equations in the case where the high-frequency wave is linearly unstable and the two lower-frequency waves are linearly damped. The solutions are shown to undergo interesting qualitative changes as the damping rate of the stable waves is increased. These changes include bifurcations to increasingly complicated periodic motions and the apparently chaotic motions, possibly indicative of the presence of a strange attractor.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 18206, 18207, 18237, 18251, 18252, 18253, 18256

18260 (DOE/ET/53057—1(Vol.1), pp 190-192) **Velocity Fourier transform solution of a model collision operator.** Catto, P.J. (Science Applications, Inc., Boulder, CO). Dec 1979.

In Magnetic Fusion Energy Program. Volume I. Introduction, technical summaries, list of publications, etc., Appendices A-K. Annual report.

A model collision operator similar to the one first introduced by Chandrasekar is employed to obtain a kinetic equation for waves in a magnetized plasma that can be solved via a velocity Fourier transform technique.

18261 Renormalized Compton scattering and nonlinear damping of collisionless drift waves. Krommes, J.A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 4, 736-745(Apr 1980).

A kinetic theory for the nonlinear damping of collisionless drift waves in a shear-free magnetic field is presented. The general formalism is a renormalized version of induced scattering on the ions and reduces correctly to weak turbulence theory. The approximation studied explicitly reduces to Compton scattering, systematizes and corrects the earlier calculations of Dupree and Tetreault [Phys. Fluids 21, 425 (1978)], and extends that theory to finite ion gyroradius. Certain conclusions differ significantly from those of Dupree and Tetreault. In particular, at long wavelengths the nonlinear ion growth rate is large and positive, proportional to k^2/sub perpendicular/D both at zero and at finite gyroradius. (Here, k/sub perpendicular/ is the perpendicular wavenumber and D is the test particle diffusion coefficient.) Nevertheless, the rate of change of total mean kinetic energy due to the nonlinear interaction is small and proportional to q^2/sub parallel/, where q/sub parallel/ is a typical parallel wavenumber.

18262 **Numerical solution of the drift kinetic equation.** Santarius, J.F.; Hinton, F.L. (Fusion Research Center, The University of Texas at Austin, Austin, Texas 78712). DE-AC05-79ET53036. *Phys. Fluids;* **23**: No. 3, 537-551(Mar 1980).

The nonadiabatic part of the electron distribution function in toroidal geometry is investigated through numerical solution of a drift kinetic equation. A Lorentz collision operator is used for both trapped and untrapped electrons. No special conditions are invoked at the trapped-untrapped electron boundary. Poloidal and pitch angle dependence of the electron guiding center drifts are included without bounce averaging. Radially local growth rates are found for the trapped electron mode with ion inertia and Landau damping retained. Comparison is made with simplified descriptions of collisions and drifts, and the dependence of growth rate and distribution function on collision frequency is examined.

18263 **Two-dimensional electrostatic E x B trapping.** Hirshman, S.P. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Fluids;* **23**: No. 3, 562-565(Mar 1980).

The nonlinear motion of a charged particle in a uniformly magnetized, two-dimensional plasma is analyzed in the presence of finite amplitude electrostatic waves traveling in the plane perpendicular to the magnetic field. In a strongly magnetized plasma, no particle trapping occurs in a single electrostatic traveling wave of arbitrary amplitude, since the induced E x B motion is orthogonal to the direction of wave propagation. However, particle orbits can be trapped when there are at least two mutually orthogonal components of the electrostatic field with finite wave amplitude cE/sub perpendicular//B> or =ω/k/sub perpendicular/ such that a particle drifts one wavelength in a waveperiod. Exact integrability of the two-wave system implies that there is no stochastic particle behavior. Perturbation of this nonlinear equilibrium by additional waves with incommensurate phase velocities will destroy the coherent island structure and lead to stochastic diffusion. The threshold amplitude for strong nonlinear behavior in the coherent wave case helps to explain the many-wave turbulence criterion for the onset of particle diffusion in a two-dimensional plasma.

18264 **Nonlinear converging resonance cones.** Wilson, J.R.; Wong, K.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). EY-76-C-02-3073. *Phys. Fluids;* **23**: No. 3, 566-572(Mar 1980).

The trajectory modification of a focused resonance cone due to ponderomotive force effects was investigated in the Princeton L-3 device. A single ring pulsed at f$_0$~50 MHz (f/sub l/h<<f/sub o/<<f/sub p/e, f/sub c/e) launches a converging resonance cone in an argon plasma with n/sub e/~10^9—10^{10}, B~400 G—1 kG, and T/sub e/~1—3 eV. At high driving power the strong localized electric fields modify the density through the ponderomotive force on the electrons, leading to a modification of the resonance cone trajectory. The cone is seen to bend in toward the axis and the focus moves toward the ring in agreement with the recent theory. When the rf is modulated, the density perturbation at the focus propagates radially outward and excites ion-acoustic waves. The wave dispersion relation was verified in He^+, Ne^+, Ar^+, and Kr^+ plasmas. Electron heating was observed which is consistent with collisional heating.

18265 **Effect of finite beta on drift-wave turbulence and particle confinement.** Hasegawa, A.; Okuda, H.; Wakatani, M. (Bell Laboratories, Murray Hill, New Jersey 07974). EY-76-C-02-3073. *Phys. Rev. Lett.;* **44**: No. 4, 248-251(28 Jan 1980).

This Letter predicts, on the basis of the structure of mode-coupling equations, that if the plasma β exceeds the square of the inverse aspect ratio, $(a/R)^2$, the cross-magnetic-field diffusion is greatly enhanced by the appearance of convective cells even in the presence of magnetic shear.

18266 **Dispersion characteristics of "warm" and "hot" plasmas.** Buneman, O. (Institute for Plasma Research, Stanford University). *Astrophys. J.:* **235**: No. 2, 616-617(15 Jan 1980).

The range of applicability of an approximate "warm" plasma dispersion formula is discussed, using as a guide the exact dispersion formula which is valid for hot, relativistic plasma.

FUSION POWER PLANT TECHNOLOGY

18267 (CONF-791102—132) **STARFIRE: a commercial tokamak reactor.** Baker, C.C.; Abdou, M.A.; DeFreece, D.A.; Trachael, A.A.; Graumann, D.; Kokoszenski, J. (Argonne National Lab., IL (USA); McDonnell Douglas Astronautics Co., St. Louis, MO (USA); General Atomic Co., San Diego, CA (USA); Parsons (Ralph M.) Co., Pasadena, CA (USA)). 1979. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The STARFIRE Project was initiated in May 1979, with the goal of completing the design study by October 1980. The purpose of this paper is to present an overview of the major parameters and design features that have been tentatively selected for STARFIRE.

18268 (CONF-791204—26) **Starfire: initial conceptual design of a commercial tokamak power plant.** Baker, C.C.; Abdou, M.A.; DeFreece, D.; Trachsel, C.; Graumann, D.; Kokszenski, J. (Argonne National Lab., IL (USA); McDonnell Douglas Astronautics Co., St. Louis, MO (USA); General Atomic Co., San Diego, CA (USA); Parsons (Ralph M.) Co., Pasadena, CA (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The purpose of the study is to provide a mechanism for the US Department of Energy to further assess the commercial potential of tokamak magnetic confinement for power reactors. The initial reference parameters for a helium cooled option are summarized. This study is placing particular emphasis on utility requirements, safety and maintenance considerations.

18269 (DOE/ET/53057—1(Vol.2), pp 658-664) **Letter from C.E. Wagner to R. Kostoff, DOE.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

This letter contains a summary of recent physics results that has direct bearing on the scientific feasibility of the Riggatron reactor concept. It includes results on the effects of the buildup of impurities, magnetic field ripples, control of the burn, and the transition from ignition to reactor burn parameters. (MOW)

18270 (DOE/ET/53057—1(Vol.2), pp 665-677) **Possibility of achieving ignition in a high-field ohmically heated tokamak.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. Appendices L-G_2. Annual report.

With today's technology it may be possible to construct a small high-field ohmically-heated tokamak which will confine a plasma capable of supporting a self-sustaining thermonuclear reaction. Results of numerical simulations of the minimum ignition conditions are presented which include empirical, sawtooth, and magnetic field ripple diffusion and the effects of impurities. An ignition condition is derived and compared with the results of the numerical simulations.

18271 (UWFDM—340) **Power balance in a tandem mirror reactor with thermal barriers.** Santarius, J.F.; Conn, R.W. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Jan 1980. Contract EY-76-S-02-2272. 33p. Dep. NTIS, PC A03/MF A01.

The tandem mirror reactor with thermal barriers has great potential for producing economic fusion power. In light of this, the present study examines the parametric dependence of important effects and seeks a preliminary set of fusion reactor design parameters. The details of the analysis are presented. A brief description is given of the numerical method involved. The parametric dependence of the equations is discussed. A set of possible reactor parameters and power flow analysis is given. Goals of central cell length of about 100 meters and Q greater than 15 were achieved.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 17872

18272 (CONF-791102—127) **First wall and blanket design for the STARFIRE commercial tokamak power reactor.** Morgan, G.D.; Trachsel, C.A.; Cramer, B.A.; Bowers, D.A.; Smith, D.L. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The first wall and blanket design concepts being evaluated for the STARFIRE commercial tokamak reactor study are presented. The two concepts represent different approaches to the mechanical design of a tritium breeding blanket using the reference materials options. Each concept has a separate ferritic steel first wall cooled by heavy water (D_2O), and a ferritic steel blanket with solid lithium oxide breeder cooled by helium. A separate helium purge system is used in both concepts to extract tritium. The two concepts are compared and relative advantages and disadvantages for each are discussed.

MAGNET COILS AND FIELDS

18273 (CONF-791102—130) **Superconducting poloidal coils for STARFIRE commercial reactor.** Wang, S.T.; Evans, K. Jr.; Turner, L.R.; Huang, Y.C.; Prater, R.; Alcorn, J. (Argonne National Lab.,

IL (USA); General Atomic Co., San Diego, CA (USA)). 1979. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

STARFIRE is considered to be the tenth commercial tokamak power plant. A preliminary design study on its superconducting poloidal coil system is presented. Key features of the design studies are: the elimination of the ohmic heating coil; the trade-off studies of the equilibrium field coil locations; and the development of a conceptual design for the superconducting equilibrium field coils. Described are the 100 kA cryostable conductor design, the coil structure and evaluation of the coil forces.

POWER SUPPLIES, ENERGY STORAGE

18274 (DOE/DP/40064—1) **Development of spark cathode electron guns for the CO_2 laser fusion program. Final report, July 1978-December 1979.** Loda, G.K.; Lindstrand, R.A. (Systems, Science and Software, Hayward, CA (USA)). Jan 1980. Contract AC08-78DP40064. 55p. Dep. NTIS, PC A04/MF A01.

Spark cathodes are designed and constructed to replace the bladed cold cathode structure in the electron guns of the Los Alamos Scientific Laboratory, Antares, prototype power amplifier and driver amplifier. Design work is described and data from cathode testing is reported. The spark cathode offers precise control of emission site location, design flexibility, and high reliability.

HEATING AND FUELING SYSTEMS

18275 (UCRL—82915) **Design and development of neutral beam module components.** Holl, P.M.; Bulmer, R.H.; Dilgard, L.W.; Horvath, J.A.; Molvik, A.W.; Porter, G.D.; Shearer, J.W.; Slack, D.S.; Colonias, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 13 Nov 1979. Contract W-7405-ENG-48. 4p. (CONF-791102—120). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The Mirror Fusion Test Facility (MFTF) injection system consists of twenty 20 keV start-up, and twenty-four 80 keV sustaining neutral beam source modules. The neutral beam modules are mounted in four clusters equally spaced around the waist of the vacuum vessel which contains the superconducting magnets. A module is defined here as an assembly consisting of a beam source and the interfacing components between that beam source and the vacuum chamber. Six major interfacing components are the subject of this paper. They are the magnetic shield, the neutralizer duct, the isolation valve, mounting gimbals, aiming bellows and actuators.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 18274

18276 (SAND—80-0367C) **Pulse-power driven light ion accelerators for fusion: the Sandia approach.** Kuswa, G.W. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 9p. (CONF-800325—1). Dep. NTIS, PC A02/MF A01.

From ASME symposium on fusion energy products; Albuquerque, NM, USA (20 Mar 1980).

Several alternative approaches to fusion are described. The light-ion beam approach at Sandia Laboratories is discussed. Pulse power systems and target experiments are described in particular. (MOW)

18277 (SAND—80-0466C) **Technological aspects of particle beam fusion.** Cook, D.L. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 11p. (CONF-800325—2). Dep. NTIS, PC A02/MF A01.

From ASME symposium on fusion energy products; Albuquerque, NM, USA (20 Mar 1980).

Reactor design considerations which are unique to the utilization of light ion beams are presented. Some of the basic technological and economic issues associated with reactor size are addressed. Advanced experimental facilities needed for the development of this technology as a power source are described, and an example of one of this technology as a power source are described, and an example of one of them is given. A few brief comments on the power supply technology which might be employable in these facilities conclude this overview.

18278 (UCID—18570) **Rad Chem data acquisition chassis users manual.** Jones, B.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1980. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

The Shiva Laser at LLL requires many forms of diagnostics to measure and analyze fusion experiments. This manual describes the operation of a Micro-Processor controlled data acquisition system designed at LLL to measure Neutron Activation during fusion experiments on the Shiva Laser.

18279 **Comments on "Analysis of spherical imploding shocks".** Lazarus, R.B. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Fluids;* **23**: No. 4, 844(Apr 1980).

It is asserted that Fujimoto and Mishkin's article is incorrect in its claim for a pressure extremum at or behind the shock for all values of γ and in its claim for an analytical form for the similarity exponent. (AIP)

18280 **Beam-diagnostics techniques for multiterawatt CO_2 lasers.** Bigio, I.J.; Jackson, S.V.; Laird, A.; Seagrave, J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Appl. Opt.;* **19**: No. 6, 914-917(15 Mar 1980).

The requirements of the Laser Fusion Program place severe demands on the ability to monitor the important parameters of the laser beams. This has resulted in the development of novel and imaginative methods to provide the various required measurements. The design and implementation of a beam-diagnostics system for the Helios laser fusion facility at Los Alamos are described.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 17870, 18164

18281 (CONF-791102—128) **Resistivity, hysteresis, and magnetization of 9% Cr stainless steel as a function of temperature and its electromagnetic shielding effects in cylindrical structures.** Praeg, W.F. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 8p. Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Ferromagnetic stainless steels may offer significantly greater wall life-times for first wall/blanket and vacuum vessel structures than commonly used non-magnetic stainless steels. One steel under consideration has the following composition, in weight percent, Fe(86.24%), Cr(9.0%) etc. The resistivity, the hysteresis loops, and magnetization were measured as a function of temperature up to the Curie point.

18282 (DOE/ET/53057—1(Vol.2), pp 652-657) **Stabilization of the burn in ETF.** Wagner, C.E. (Science Applications, Inc., La Jolla, CA). Dec 1979.

In Magnetic Fusion Energy Program. Volume II. \ppendices L-G_2. Annual report.

In ETF it is desired to maintain burn parameters of anti T/sub i/ approx. = to 12 keV, anti n/sub H/ approx. = to $10^{20}/m^3$, P/sub n/ approx. = to to 1100 MW constant over a period nominally of about 500 sec. This clearly will require some feedback control mechanism since, left to its own, the equilibrium operating-point temperature would rise to an unacceptably high value thus leading to unstable values to β, large synchrotron emission, and a rapid buildup to He ash. It has been proposed that the burn may be effectively controlled by adding ripple to the confining toroidal field. In this note we investigate this possibility coupled with maintaining the density with pellet injection.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 18284

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 17719, 18096

18283 (ANL/NESC—1) **National Energy Software Center: installation representative guide.** (Argonne National Lab., IL (USA)). Sep 1979. Contract W-31-109-ENG-38. 46p. Dep. NTIS, PC A03/MF A01.

This guide is intended as an introduction and reference manual to the program and operating procedures of the National Energy Software Center (NESC). NESC serves as a software exchange and information center for the US DOE. The role of the installation representative is that of liaison with the Center. The report describes the history of the Center, Center activities (information services, software exchange, ACCESS (Argonne Code Center Exchange and Storage System) activities, cooperative efforts), and the role of the installation representative (preparation of NESC

summaries, submission of program packages, and requests for library software). (RWR)

18284 (CONF-790212—(Summ.)) **Operations managers conference: summary of proceedings.** (Department of Energy, Washington, DC (USA). Office of Computer Services and Telecommunications Management). Feb 1980. 67p. Dep. NTIS, PC A04/MF A01.

From Association for energy systems, operations, and programming (AESOP) operations managers meeting; Carmel, CA, USA (13 Feb 1979).

The fifth AESOP Operations Managers Conference was held in Carmel, California on February 13-15, 1979. The keynote address dealt with the changing role of the computer operations manager. Representatives presented contrasting approaches to managing the procurement and installation of new computer systems. The advantages and disadvantages of maintaining strong internal management support and good communication with the vendor and of increasing the involvement of broad-based planning committees and operations personnel in the computer procurement process were discussed. Two promising management programs, the PEER and 10/40 systems proved effective in improving employee morale by reducing job fragmentation, increasing internal mobility and modifying the work week. The topic of unionization of operations personnel was also discussed. The uneasy relationship between computers and the energy shortage was also considered. Techniques for avoiding computer problems caused by blackouts and brownouts were presented. The difficulty of conserving power at a computer facility was also discussed. Presentations concerning the President's committee on ADP reorganizaion and methods for predicting trends in computer innovation were made. Abstracts and two-page summaries of the papers given are included in this report.

18285 (CONF-800122—1) **Programming methodology of artificial intelligence.** Johnson, C.K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

From International winter school on crystallographic computing; Bangalore, India (4 Jan 1980).

Some of the non-numerical methods developed in the branch of computer science known as artificial intelligence (AI) have been designed specifically for the task of encoding empirical rules of good judgment into a form suitable for machine reasoning. This article summarizes the production-rule technique, one of the principal AI programming techniqes currently used in the knowledge engineering area of AI. An illustrative application involving the interpretation of protein electron-density maps is also described. 4 figures, 1 table.

18286 (COO—2383-0061) **ODEs: is there anything left to do.** Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1979. Contract EY-76-S-02-2383. 32p. (UIUCDCS-R—79-983; UILU-ENG—79-1731). Dep. NTIS, PC A03/MF A01.

Two decades ago many people thought that there was very little left to occupy the researcher in the numerical initial-value problem for ordinary differential equations, but there has since been an enormous increase in the effort devoted to this problem and related software. The question is whether everything is finally done so that more difficult areas can be studied. The development of numerical solution techniques is examined from the identification of a problem to the never-final preparation of automatic codes for the solution of classes of similar problems. A number of ODE problems that are only a part of the way along this path of development are discussed. These problems include ones with highly oscillatory solutions, ones with frequent discontinuities, and ones in which very little accuracy is needed (and which should be integrated at low cost). 4 figures.

18287 (EGG-IS—5101) **MAGNUM 1.0: an ISDMS interactive graphics processor.** Bruestle, H.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1980. Contract EY-76-C-07-1570. 80p. Dep. NTIS, PC A05/MF A01.

MAGNUM 1.0 is an interactive graphics program residing in the Idaho National Engineering Laboratory Scientific Data Management System (ISDMS). It is designed to handle a number of file formats containing data to be either mathematically manipulated or plotted. The objectives in writing MAGNUM 1.0 were that it be fast, small, easy to use, and versatile. The code is currently implemented on a CDC CYBER 173 and CYBER 176 running under the NOS/BE operating system. The TEKTRONIX PLOT-10 product is utilized as the plotting software. A set of color commands is available to the user of the Model 4027 color CRT. MAGNUM 1.0 performs extensive error checking; hence, the user need not worry about invalid inputs. The code maintains a default table that minimizes the number of commands required to produce a basic plot. (RWR)

18288 (LBL—10409) **National Resource for Computation in Chemistry (NRCC). Attached scientific processors for chemical computations: a report to the chemistry community.** Ostlund, N.S. (Arkansas Univ., Fayetteville (USA). Dept. of Chemistry; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

The demands of chemists for computational resources are well known and have been amply documented. The best and most cost-effective means of providing these resources is still open to discussion, however. This report surveys the field of attached scientific processors (array processors) and attempts to indicate their present and possible future use in computational chemistry. Array processors have the possibility of providing very cost-effective computation. This report attempts to provide information that will assist chemists who might be considering the use of an array processor for their computations. It describes the general ideas and concepts involved in using array processors, the commercial products that are available, and the experiences reported by those currently using them. In surveying the field of array processors, the author makes certain recommendations regarding their use in computational chemistry. 5 figures, 1 table (RWR)

18289 (SAND—80-0181) **Comparison of software which solves systems of nonlinear equations.** Hiebert, K.L. (Sandia Labs., Albuquerque, NM (USA)). Mar 1980. Contract EY-76-C-04-0789. 50p. Dep. NTIS, PC $6.15/MF $3.50.

This report compares eight readily available FORTRAN codes that solve nonlinear systems of equations. The eight codes are C05NAF, BRENT, HYBRD, NS01A, QN, SOSNLE, ZONE, and ZSYSTM. (The report comments on two additional codes, C05PAF and ZONEJ, but these codes are not included in the comparison. The report includes general information about the codes, such as methods implemented, return criteria, calling sequence, return status information, storage requirements, print options, and other special features. The main emphasis of the testing is the robustness of the code. Much care was taken in setting the parameters used by the codes so that tests are made as equivalent as possible and the comparisons unbiased. Then the performance of the codes on the test problems is reviewed. Information on the efficiency of the codes (function evaluation counts and time) is presented. The conclusions are based on the robustness of both the individual codes and the methods that they implement. This report serves two purposes. First, it defines the state of the art of software that solves systems of nonlinear equations (i.e., identifies areas in which the codes perform well and areas that need improving.) Second, the conclusions based on robustness and the other information (efficiency measurements, storage requirements, and special features) can provide the user a guide in choosing the most appropriate code for his needs. 8 figures, 6 tables. (RWR)

18290 (SAND—80-0430C) **Using the sequential regression (SER) algorithm for long-term signal processing.** Soldan, D.L.; Ahmed, N.; Stearns, S.D. (Kansas State Univ., Manhattan (USA). Dept. of Electrical Engineering; Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 4p. (CONF-800404—2). Dep. NTIS, PC A02/MF A01.

From IEEE international conference on acoustics, speech, and signal processing; Denver, CO, USA (Apr 1980).

The use of the sequential regression (SER) algorithm [Electron. Lett., 14, 118(1978); 13, 446(1977)] for long-term processing applications is limited by two problems that can occur when an SER predictor has more weights than required to predict the input signal. First, computational difficulties related to updating the autocorrelation matrix inverse could arise, since no unique least-squares solution exists. Second, the predictor strives to remove very low-level components in the input, and hence could implement a gain function that is essentially zero over the entire passband. The predictor would then tend to become a no-pass filter which is undesirable in certain applications, e.g., intrusion detection [SAND—78-1032]. Modifications to the SER algorithm that overcome the above problems are presented, which enable its use for long-term signal processing applications. 3 figures.

18291 (UCID—17139(Rev.1)) **ZONE - a finite element mesh generator.** Burger, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Mar 1980. Contract W-7405-ENG-48. 33p. Dep. NTIS, PC A03/MF A01.

The ZONE computer program is a finite element mesh generator that produces the nodes and element description of any two-dimensional geometry. The geometry is subdivided into a mesh of quadrilateral and triangular zones arranged sequentially in an ordered march through the geometry. The order of march can be chosen so that the minimum bandwidth is obtained. The node points are defined in terms of the x and y coordinates in a global rectangular coordinate system. The zones generated are quadrilaterals or triangles defined by four node points in a counterclockwise sequence. Node points defining the outside boundary are generated for slide lines and to describe pressure boundary conditions. The mesh that is generated can be used as input to any two dimensional as well as any axisymmetrical structure program. The following points are taken up: program concept and characteristics; regions; layers; meridians (offset, circular arc, ellipse); rays; common characterstics - rays and meridians, ZONE input description; output files; examples;

and program availability. Also generated is the input to the program PLOT. 15 figures. (RWR)

18292 (UCID—18546) **TRIPLE: a dynamic storage package.** Steward, J.J. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Feb 1980. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

The main purpose of the package, TRIPLE, is to allow the user to specify the number of arrays and the number of words per array to be stored by the package at execution time. The package will either store these arrays in the memory area of the program or use disks for temporary storage. The upper limit on the total number of words that can be stored is approximately 100(200) million words on CDC 7600 (Cray-1). The paakage, in some sense, allows the user to dynamically dimension those arrays to be stored by the package. The real virtue of the package is that it performs all the necessary functions to transfer the data it stores into the memory area of the program for use. Succeeding sections discuss in detail the following topics: triple buffering and how the package implements it, package I/O and file requirements needed for storage using disks, storage requirements necessary to store user arrays, allocation of storage when the user either works within the package's work areas or uses his own distinct work area, set-up of SETARRAY if transfers are to be enabled, obtaining and setting up the package and the subroutine calls needed to implement the package, key points necessary to use the package. (RWR)

18293 (UCID—18549) **Analysis of a 2-D code on the CRAY-1.** Rudy, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1980. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

The results of the conversion of a 2-D time-dependent finite-difference code from a CDC 7600 to the Cray-1 are described. The performance improvement, degree of vectorization, and output characteristics on the Cray-1 are presented. 4 tables.

18294 (UCRL—83985) **Timer-based mechanisms in reliable transport protocol connection management: a comparison of the TCP and Delta-t protocol approaches.** Watson, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Feb 1980. Contract W-7405-ENG-48. 6p. (CONF-800511—1). Dep. NTIS, PC A02/MF A01.

From Trends and applications symposium; Gaithersburg, MD, USA (29 May 1980).

There is a need for timer-based mechanisms (other than retransmission timers) to achieve reliable connection management in transport protocols. This need is illustrated by comparing the timer mechanisms in the Department of Defense Transmission Control Protocol (TCP), initially designed using only a message exchange based mechanism, and in the Lawrence Livermore Laboratory Delta-t protocol, designed explicitly to be timer based. The bounding of maximum packet lifetime and related parameters for achieving transport protocol reliability are important, and a mechanism is outlined for enforcing such a bound.

18295 **Choosing the points in product integration.** Sloan, I.H. (Department of Physics and Astronomy Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *J. Math. Phys. (N.Y.);* **21**: No. 5, 1032-1039(May 1980).

A product-integration rule for the integral ∫/sup b//sub a/k (t) f (t) dt is a rule of the form summation/sup n//sub i/=1w/sub i/ f (t/sub i/), with the weights $w_1,...,w$/sub n/ chosen so that the rule is exact if f is any linear combination of a chosen set of functions $phi_1,...,phi$/sub n/ . For some choices of {phi/sub j/}, including the polynomial case, the points {t/sub i/} need to be carefully chosen if reliable results are to be obtained. In this paper known convergence results for the polynomial case with well-chosen points are summarized and illustrated, and extended to some nonpolynomial cases, including one proposed by Y.E. Kim for use in solving the three-body Faddeev equations. The convergence theorems yield practical prescriptions for choosing the points {t/sub i/} .

18296 **Missing label operators in the reduction Sp(2n) arrow-downSp(2n-2).** Bincer, A.M. (Physics Department, University of Wisconsin-Madison, Madison, WI 53706). EY-76-C-02-0881. *J. Math. Phys. (N.Y.);* **21**: No. 4, 671-674(Apr 1980).

I consider the "missing label" problem for basis vectors of an Sp(2n) representation corresponding to a group reduction chain with links Sp(2ν) arrow-downSp(2ν-2) x U(1), 2< or =ν< or =n. I obtain two different sets of ν-1 missing label operators. These operators, together with the ν Casimir operators of the Sp(2ν) group, the ν-1 Casimir operators of the Sp(2ν-2) subgroup and the one generator of the U(1) subgroup, form a complete set of labeling operators whose eigenfunctions provide a canonical basis in the representation space of Sp(2ν). When the number of missing labels exceeds one the most general solution to the labeling problem is not known. The two particular solutions presented here have certain appealing aspects of symmetry and simplicity.

18297 **Enhancement of solar corona and comet details.** Matuska, W. Jr.; Janney, D.H.; Farrell, J.A.; Keller, C.F. Jr. (Los Alamos Scientific Lab., NM). *Opt. Eng.;* **17**: No. 6, 661-665(Nov 1978).

Finely detailed striae in astronomical images can be important in formulation of theory. Examples are studies of streamers in the solar corona and of dust tails in comets. In both instances, conventional observations fail to reveal much of the structural detail. Digital image processing has been used at Los Alamos Scientific Laboratory (LASL) for enhancing these images. The corona images have tremendous variations in film density which must be eliminated before the fine striae can be seen. These variations can be removed by means of numerical modeling of their spatial relation to the sun. This model can be thought of as a surface of background film density. In the comet images the overall variation is less severe. Further, the large number of comet images makes it infeasible to model them individually. Hence, an extreme low-pass filter was used to create an image which can be used as the background surface. In both cases, the background surface is divided into the original image pixel by pixel. This quotient image is then frequency-filtered for edge enhancement or noise control. Nonlinear density transformations are then used to enhance contrast. For both types of images, heretofore unmeasurable details become readily visible for analysis.

INFORMATION HANDLING

18298 (K/D—5070) **Computer-aided readability measurements.** Schulman, N.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). May 1980. Contract W-7405-ENG-26. 9p. (CONF-800509—1). Dep. NTIS, PC A02/MF A01.

From 27. international technical communication conference; Bloomington, MN, USA (14 May 1980).

General Motors Research Laboratories has developed a computer program that determines the relative reading difficulty of samples of written material. The program is based on the Flesch Reading Ease Index, a formula for computing the grade level of samples of text. The Flesch Index is well suited for computer use because it does not require semantic information and its application is not subject to operator interpretation. The computer program, Simple Test for Readability (STAR), uses little on-line storage space, and its BASIC and FORTRAN versions can run on most computer systems. The logic of the program, problem areas, and application suggestions are discussed. (RWR)

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DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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1553	5:17699	*See* COO-4711-20
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613-2312	5:17865	Dep. NTIS, PC A03/MF A01
613-2332	5:17955	Dep. NTIS, PC A02/MF A01
613-2336	5:17956	Dep. NTIS, PC A02/MF A01
BM-RI-		
8411	5:17844	Bureau of Mines, Pittsburgh, PA
BNL-		
27148	5:18071	Dep. NTIS, PC A04/MF A01
27208	5:17851	Dep. NTIS, PC A02/MF A01
27324	5:17970	Dep. NTIS, PC A02/MF A01
CCMS-		
93	5:17542	*See* DOE/CS-0145
CISE-		
1517	5:17486	Dep. NTIS (US Sales Only), PC A02/MF A01
CONF-760949-	(3. colloquium on electronic transition lasers, Aspen, CO, USA, 7-10 Sep 1976)	
	5:17950	Cambridge, MA; Massachusetts Institute of Technology Press (1977).
CONF-7706168-	(Conference on materials for high temperature energy sources, Odeillo, France, 27 Jun-9 Jul 1977)	
	5:17875	Dep. NTIS (US Sales Only), PC A23/MF A01
	5:17879	Dep. NTIS (US Sales Only), PC A23/MF A01
CONF-7710101-	(5. national conference on energy and the environment, Cincinnati, OH, USA, 31 Oct-3 Nov 1977)	
	5:18035	Dayton, OH; American Institute of Chemical Engineers (1978).
CONF-7710189-	(3. annual oceans conference, Los Angeles, CA, USA, 17-19 Oct 1977)	
P1	5:18097	New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).
P2	5:18098	New York, NY; Institute of Electrical and Electronics Engineers, Inc. (1977).
CONF-780744-	(1. conference on energy and community development, Athens, Greece, 10-15 Jul 1978)	
3	5:18013	Dep. NTIS, PC A02/MF A01
CONF-7808115-	(Workshop on ionospheric and magnetospheric effects of satellite power systems, Rosemont, IL, USA, 28-30 Aug 1978)	
	5:18012	Dep. NTIS, PC A06/MF A01
CONF-7811142-	(Royal Society discussion meeting on solar energy, London, UK, 15-16 Nov 1978)	
1	5:17507	*See* SERI/TP-32-134
CONF-781247-	(2. international conference on energy storage, compression and switching, Venice, Italy, 5-8 Dec 1978)	
6	5:17944	*See* DOE/ER/70004-259
CONF-790108-	(1979 SPE international symposium on oilfield and geothermal chemistry, Houston, TX, USA, 22-24 Jan 1979)	
5	5:17651	*See* LBL-7090
CONF-790167-	(Workshop on power plant availability engineering and productivity improvement, Los Angeles, CA, USA, 9-12 Jan 1979)	
(Vol.2)	5:17685	Dep. NTIS, PC A21/MF A01
CONF-790212-	(Association for energy systems, operations, and programming (AESOP) operations managers meeting, Carmel, CA, USA, 13-15 Feb 1979)	
(Summ.)	5:18284	Dep. NTIS, PC A04/MF A01
CONF-790248-	(Lifetime in silicon symposium, San Diego, CA, USA, 15-16 Feb 1979)	
1	5:17838	Dep. NTIS, PC A02/MF A01
CONF-790501-	(Wind energy innovative systems conference, Colorado Springs, CO, USA, 23-25 May 1979)	
	5:17655	*See* SERI/TP-245-184
	5:17656	*See* SERI/TP-245-184
	5:17658	*See* SERI/TP-245-184
	5:17661	*See* SERI/TP-245-184
	5:17662	*See* SERI/TP-245-184
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	5:17672	*See* SERI/TP-245-184
	5:17673	*See* SERI/TP-245-184
	5:17674	*See* SERI/TP-245-184
	5:17675	*See* SERI/TP-245-184
	5:17676	*See* SERI/TP-245-184
	5:17678	*See* SERI/TP-245-184

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	5:17679	*See* SERI/TP-245-184
	5:17680	*See* SERI/TP-245-184
CONF-790679-		(3. annual EPRI geothermal conference, Monterey, CA, USA, 26-29 Jun 1979)
	5:17609	*See* EPRI-WS-79-166
	5:17610	*See* EPRI-WS-79-166
	5:17611	*See* EPRI-WS-79-166
	5:17612	*See* EPRI-WS-79-166
	5:17615	*See* EPRI-WS-79-166
	5:17620	*See* EPRI-WS-79-166
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	5:17640	*See* EPRI-WS-79-166
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	5:17645	*See* EPRI-WS-79-166
	5:17646	*See* EPRI-WS-79-166
	5:17647	*See* EPRI-WS-79-166
	5:17648	*See* EPRI-WS-79-166
	5:17649	*See* EPRI-WS-79-166
	5:17650	*See* EPRI-WS-79-166
CONF-7906137-		(Lecture meeting on optimized energy economy in industry, Essen, F.R. Germany, 5 Jun 1979)
3	5:17773	*See* INKA-Conf-79-171-003
CONF-7906152-		(Symposium on epidemiological problems in genetics, Reykjavik, Iceland, Jun 1979)
1	5:18039	Dep. NTIS, PC A02/MF A01
CONF-790742-		(NSPE energy seminar, Knoxville, TN, USA, 8-14 Jul 1979)
	5:17936	Dep. NTIS, PC A04/MF A01
CONF-790779-		(Software standards in chemistry conference, Salt Lake City, UT, USA, 25-27 Jul 1979)
(DRAFT)	5:17896	*See* LBL-9881(DRAFT)
CONF-790845-		(Solar 79 Northwest conference, Seattle, WA, USA, 10-12 Aug 1979)
	5:17482	Dep. NTIS, PC A19/MF A01
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CONF-790892-		(Computational methods for molecular structural determination: theory and technique, Bloomington, IN, USA, 13-24 Aug 1979)
	5:17897	*See* LBL-9882
CONF-7908106-		(Conference on 3H toxicity, Upton, NY, USA, 3 Aug 1979)
(Summ.)	5:18071	*See* BNL-27148
CONF-790923-		(Decontamination and decommissioning of nuclear facilities conference, Sun Valley, ID, USA, 16-19 Sep 1979)
10	5:17697	*See* PNL-SA-7535
CONF-790954-		(18. international conference on solar energy, Milan, Italy, 23-27 Sep 1979)
2	5:17486	*See* CISE-1517
CONF-7909122-		(Symposium on electron beam therapy, New York, NY, USA, 25-27 Sep 1979)
1	5:18048	Dep. NTIS, PC A02/MF A01
CONF-7909123-		(International symposium on aromaticity, Dubrovnik, Yugoslavia, 3-5 Sep 1979)
1	5:17919	*See* ISM-244
CONF-791013-		(26. national vacuum symposium, New York, NY, USA, 2-5 Oct 1979)
11	5:17429	*See* RFP-2939
CONF-791102-		(8. symposium on engineering problems of fusion research, San Francisco, CA, USA, 13-16 Nov 1979)
120	5:18275	*See* UCRL-82915
127	5:18272	Dep. NTIS, PC A02/MF A01
128	5:18281	Dep. NTIS, PC A02/MF A01
130	5:18273	Dep. NTIS, PC A02/MF A01
131	5:17460	Dep. NTIS, PC A02/MF A01
132	5:18267	Dep. NTIS, PC A02/MF A01
CONF-791103-		(American Nuclear Society meeting, San Francisco, CA, USA, 12-16 Nov 1979)
71	5:17743	*See* GA-A-15499
CONF-791108-		(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)
19	5:17476	*See* LBL-10219
21	5:17726	Dep. NTIS, PC A02/MF A01
CONF-791112-		(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26 Nov 1979,-29 Nov 1979/REPLACES CONF-791173)
53	5:17449	*See* UCRL-82228(Rev.1)
CONF-791134-		(16. international thermal conductivity conference, Chicago, IL, USA, 7-9 Nov 1979)
11	5:17878	Dep. NTIS, PC A02/MF A01
CONF-791143-		(Users Association solar fuels workshop, Albuquerque, NM, USA, 28-29 Nov 1979)
5	5:17577	*See* LBL-10484
CONF-791145-		(International symposium on trace elements stress in plants, Los Angeles, CA, USA, 6-9 Nov 1979)
1	5:18081	*See* ISM-260
CONF-791151-		(Inhomogeneous superconductors conference, Berkeley Springs, WV, USA, 1-3 Nov 1979)
	5:17850	58: No. 1, 58-66(15 Dec 1979)
	5:17862	58: No. 1, 197-202(15 Dec 1979)
	5:17863	58: No. 1, 203-206(15 Dec 1979)
	5:17864	58: No. 1, 216-226(15 Dec 1979)
	5:17882	58: No. 1, 67-78(15 Dec 1979)
	5:17883	58: No. 1, 288-292(15 Dec 1979)
	5:18192	58: No. 1, 176-185(15 Dec 1979)
CONF-791166-		(Thermochemical conversion contractors' meeting, Rolla, MO, USA, 7 Nov 1979)
1	5:17475	*See* LBL-10091
CONF-791171-		(Specialty conference on transportation and the 1977 Clean Air Act Amendment, San Francisco, CA, USA, 13 Nov 1979)
1	5:17829	Dep. NTIS, PC A02/MF A01
CONF-791174-		(Meeting on two-nucleon systems and dibaryon resonances, Hiroshima, Japan, Nov 1979)
1	5:18118	*See* ANL-HEP-CP-80-01
4	5:17970	*See* BNL-27324
CONF-791204-		(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)
25	5:17606	Dep. NTIS, PC A02/MF A01
26	5:18268	Dep. NTIS, PC A02/MF A01
29	5:17735	Dep. NTIS, PC A02/MF A01
30	5:17569	Dep. NTIS, PC A02/MF A01
31	5:17539	Dep. NTIS, PC A02/MF A01
33	5:17532	*See* SLAC-PUB-2477
CONF-791205-		(ASME winter annual meeting, New York, NY, USA, 2-7 Dec 1979)
18	5:17727	Dep. NTIS, PC A02/MF A01
CONF-791221-		(Semiannual conference for advanced solar thermal technology, Phoenix, AZ, USA, 11-13 Dec 1979)
	5:17517	*See* SERI/TP-313-492
	5:17518	*See* SERI/TP-313-492
	5:17519	*See* SERI/TP-313-492
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CONF-791232-	(Thermal energy storage review meeting, Tysons Corner, VA, USA, 3-4 Dec 1979)	
1	5:17608	*See* SERI/TP-333-497
CONF-800101-	(Systems simulation and economics analysis conference, San Diego, CA, USA, 23-25 Jan 1980)	
14	5:17545	*See* LBL-10352
16	5:17481	*See* SERI/TP-453-539
18	5:17544	*See* LA-UR-80-387
CONF-800106-	(14. photovoltaics specialists conference, San Diego, CA, USA, 7-10 Jan 1980)	
23	5:17487	Dep. NTIS, PC A02/MF A01
24	5:17488	Dep. NTIS, PC A02/MF A01
CONF-800118-	(2. AES design and finishing of printed wiring and hybrid circuits symposium, San Francisco, CA, USA, 15-17 Jan 1980)	
1	5:17956	*See* BDX-613-2336
2	5:17955	*See* BDX-613-2332
CONF-800119-	(NRC/IEEE working conference on advanced electrotechnology applications to nuclear power plants, Washington, DC, USA, 15-17 Jan 1980)	
1	5:17976	*See* SAND-80-0362C
CONF-800122-	(International winter school on crystallographic computing, Bangalore, India, 4-14 Jan 1980)	
1	5:18285	Dep. NTIS, PC A02/MF A01
CONF-800125-	(Environmental Protection Agency oxidants research planning workshop, Raleigh, NC, USA, 27-30 Jan 1980)	
1	5:18082	Dep. NTIS, PC A02/MF A01
2	5:18083	Dep. NTIS, PC A02/MF A01
CONF-800130-	(Workshop on the organizational and procedural aspects of management of nuclear reactor accidents, Laxenburg, Austria, 28-31 Jan 1980)	
1	5:17736	Dep. NTIS, PC A03/MF A01
CONF-800131-	(Nuclear structure with intermediate energy probes workshop, Los Alamos, NM, USA, 14-17 Jan 1980)	
5	5:18175	Dep. NTIS, PC A02/MF A01
38	5:18132	Dep. NTIS, PC A02/MF A01
CONF-800132-	(American Society of Limnology and Oceanography winter meeting, Los Angeles, CA, USA, 31 Jan-4 Feb 1980)	
1	5:18026	*See* DP-MS-79-107
CONF-800206-	(American Society of Heating, Refrigeration, and Air Conditioning Engineers semi-annual meeting, Los Angeles, CA, USA, 3-7 Feb 1980)	
4	5:17798	*See* LBL-10117
CONF-800210-	(IEEE Region 6 conference, San Diego, CA, USA, 20-22 Feb 1980)	
2	5:17379	Chicago, IL; Institute of Gas Technology (1980).
CONF-800211-	(International symposium on management of gaseous wastes from nuclear facilities, Vienna, Austria, 18-21 Feb 1980)	
2(Draft)	5:17433	Dep. NTIS, PC A03/MF A01
CONF-800212-	(7. annual energy conference and exhibition during National Engineers' week, Knoxville, TN, USA, 20-22 Feb 1980)	
1	5:17777	Dep. NTIS, PC A02/MF A01
3	5:17953	*See* K/D-5077
CONF-800214-	(9. annual symposium of the Florida Chapter of the American Vacuum Society, Tampa, FL, USA, 11-13 Feb 1980)	
2	5:17814	*See* GEPP-OP-483
CONF-800215-	(Atlantic Economic Society annual meeting, Freeport, Bahamas, 10-15 Feb 1980)	
1	5:17764	Dep. NTIS, PC A03/MF A01
CONF-800226-	(Specialists meeting on decay heat removal and natural circulation in FBR's, Upton, NY, USA, 28-29 Feb 1980)	
1	5:17737	Dep. NTIS, PC A02/MF A01
3	5:17871	*See* HEDL-SA-1924-FP
CONF-800228-	(32. annual meeting of the American Academy of Forensic Sciences, New Orleans, LA, USA, 20-23 Feb 1980)	
1	5:18062	*See* COO-3017-40
CONF-800303-	(179. national meeting of the American Chemical Society, Houston, TX, USA, 23-28 Mar 1980)	
8	5:17933	*See* DP-MS-79-93
10	5:17899	Dep. NTIS, PC A02/MF A01
CONF-800304-	(5. international congress of the International Radiation Protection Association, Jerusalem, Israel, 8-14 Mar 1980)	
10	5:18064	*See* LBL-10494
CONF-800305-	(Corrosion/80 NACE meeting, Chicago, IL, USA, 6-10 Mar 1980)	
6	5:17866	Dep. NTIS, PC A02/MF A01
7	5:17435	*See* IS-M-273
CONF-800313-	(Waste management conference, Tucson, AZ, USA, 10 Mar 1980)	
3	5:17434	Dep. NTIS, PC A02/MF A01
4	5:17455	*See* UCRL-82236
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2	5:17457	*See* MLM-2699(OP)
3	5:17458	*See* UCRL-82222
4	5:17459	*See* UCRL-82224
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2	5:17957	*See* LA-UR-80-667
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1	5:18276	*See* SAND-80-0367C
2	5:18277	*See* SAND-80-0466C
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3	5:17997	*See* UCRL-83269
CONF-800332-	(4. power plant dynamics, control and testing symposium, Gatlinburg, TN, USA, 17-19 Mar 1980)	
2	5:17720	*See* GA-A-15741
3	5:17738	Dep. NTIS, PC A02/MF A01
CONF-800333-	(11. annual meeting of the World Mariculture Society, New Orleans, LA, USA, 3-7 Mar 1980)	
1	5:18049	*See* LBL-10435
CONF-800402-	(International symposium on the properties and applications of metal hydrides, Colorado Springs, CO, USA, 7-11 Apr 1980)	
1	5:17841	*See* SAND-9-1541C
3	5:17842	*See* SAND-80-0288C
7	5:17851	*See* BNL-27208
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11	5:17747	*See* SAND-79-2114C
CONF-800404-	(IEEE international conference on acoustics, speech, and signal processing, Denver, CO, USA, Apr 1980)	
2	5:18290	*See* SAND-80-0430C
CONF-800406-	(Wind energy conference, Boulder, CO, USA, 9-11 Apr 1980)	
4	5:17663	*See* DOE/NASA/1028-80/26
CONF-800413-	(Scanning electron microscopy meeting, Chicago, IL, USA, 22-25 Apr 1980)	
1	5:17974	*See* LA-UR-80-390
CONF-800419-	(5. symposium on automotive propulsion systems, Dearborn, MI, USA, 14-18 Apr 1980)	
1	5:17806	Dep. NTIS, PC A03/MF A01
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1	5:17733	*See* UNI-SA-72
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1	5:17975	*See* SAND-79-1885C
2	5:17977	*See* UCRL-84027
4	5:17579	*See* SAND-80-0583C
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1	5:17619	*See* SAND-80-0379C

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1	5:18298	*See* K/D-5070
CONF-800511-		(Trends and applications symposium, Gaithersburg, MD, USA, 29 May 1980)
1	5:18294	*See* UCRL-83985
CONF-800516-		(14. international symposium on atmospheric pollution, Paris, France, 5-7 May 1980)
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